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THE BEGINNINGS OF SCIENCE

EDWARD J. MENGE

IN MEMORIAM
A. F. Lange

Education Department

UNIV. OF
CALIFORNIA

UNIV. OF CALIFORNIA

BADGER'S STUDIES IN SCIENCE

THE HIGHER USEFULNESS OF SCIENCE
By William Emerson Ritter

THE UNITY OF THE ORGANISM
By William Emerson Ritter

THE BEGINNINGS OF SCIENCE
By Edward J. Menge

THE PROBABLE INFINITY OF NATURE AND LIFE
By William Emerson Ritter

RICHARD G. BADGER, PUBLISHER, BOSTON

THE BEGINNINGS OF SCIENCE

Biologically and Psychologically Considered

By

EDWARD J. MENGE, M.A., PH.D., M.Sc.

Professor of Biology in the University of Dallas
Author of "Backgrounds for Social Workers"

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Prof A. F. Lange
to Education Dept

Made in the United States of America

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TO

MY WIFE

WHOSE CONSTANT ENCOURAGEMENT
AND NEVER-WAVERING CONFIDENCE
HAVE BEEN THE SOURCE OF THE
AUTHOR'S MOST FRUITFUL STUDIES

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PREFACE

IT is now some ten years since the need of a volume in non-technical language, describing the relationship between Philosophy and the Laboratory Sciences, was brought home to the author, and with the end in view of filling that need, he began the series of studies which have made this book possible.

Six of the chapters have already appeared in print in the University of Dallas Quarterly Bulletins during the past few years, while much of the remaining material has been used in class-room and public lectures.

Students from all schools have seemed so one-sided in their viewpoint, that the desire to make them realize that many varying conclusions may often be drawn from the same facts, with just as much validity, has led to the often repeated stressing of this fact throughout these pages; and, having noticed that most students lose the thread of their reading when too many foot-notes are employed, we have tried, wherever possible, to embody what is usually placed in foot-notes, in the main portion of the paragraph.

Contrary to most volumes written on any subject, we have tried to present *both sides* when there were two, or more should that be the case. We have likewise tried to show where much error may be found in the teaching of both high-school and college students, in that not sufficient stress is laid on the all-important difference between FACTS and INTERPRETATIONS—on the varying and often contradictory beliefs of writers on Evolutionary Science—on the deplorable

lack of logical and philosophical thinking—on the fallacy of permitting the student to assume that because an hypothesis is necessary for experimental purposes, it must be true; and that because every teacher in a given school may uphold a doctrine, it does not follow that all men hold it, for the head of the department usually employs only those teachers who think along similar lines, or very often are the result of his own training, they having been his own pupils.

W. H. Mallock has well said that the laboratory man has had to go to school to philosophy, and it is this point we wish to emphasize more than any other.

We have therefore tried to present NECESSARY STUDIES, which *must* form the foundation of any valid interpretation of any facts found, by placing a goodly list of books and articles in our chapter on "Suggested Readings" that will bring home the ideas expressed in this Preface and permit a far more comprehensive knowledge of LIFE in general than any course or courses the average student is likely to get at any institution, unless he specialize for many years.

In other words, the object and aim of the author has been to show what is necessary for a broad, logical, and clear-cut view of Life; what theories are held by able men in all the various walks of life; where and how they agree and where and how they do not agree—to give perspective.

Great pains have been taken to make every statement, date and reference accurate, but should any errors have crept in, the author will consider it a favor to have his attention called to them.

Thanks are due to all the members of the faculty of the University of Dallas for their ready assistance and kindliness, but especially to the Reverend Peter P. Finney, C.M., Ph.D., Professor of Philosophy, whose kindly suggestions

and wide knowledge in his chosen field have been of untold assistance.

Thanks are also due to my assistant, Mr. Fred Rich, B.A., for the careful drawings he has made for these pages.

EDWARD J. MENGE

University of Dallas, Texas.
April 6, 1917.

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UNIV. OF CALIFORNIA

THE BEGINNINGS OF SCIENCE

CHAPTER I

BIOLOGICAL LABORATORIES

The Reason for Their Existence

MORE and more the classics are being neglected for the modern scientific courses: class-room is converted into laboratory and the subjects of interest to a past generation of college men and women seem to have gone from the halls of learning and left in their stead but echoes—echoes which are ever and ever growing fainter until sometimes it seems that even *they* will shortly cease. And then come the questions: "Why has the college and high-school curriculum so changed?" and "Of what value are the new studies?" Questions which ever and ever become more insistent in their demand for an adequate answer.

The student, when challenged, quite naturally wishes to defend himself, but how often he fails we know too well; men and women, though long since away from the class-room, who yet find their interests along scientific lines and possess that faculty of wanting to know a "why" for everything; parents who cannot understand why their children should not pass through the same training as did they; and that great mass of boys and girls who find themselves unable to attend any

of our schools of higher learning, but spend their leisure moments in working, and dreaming, and yearning for the time when better things await them, and who now treasure every scrap of scientific wisdom and fact, but, who, unable to explain the practical value of it all, find heartaches which so often come from being condemned and misunderstood by those at home—for all these this little volume is written, and it is hoped that what is herein contained, may stimulate to efforts along lines that will make its readers capable of knowing "WHY."

It is well at the outset, to bear in mind that practically every discussion has at least two sides, and often many more. An example that comes to mind is the public library. There are those who insist that the object of a library must be to furnish those particular books which people *wish to read;* yet certainly something may be said for those who believe that only a few of the wished-for volumes should be kept, and these but incidentally—only in order that they may lead men and women to wish for those that are really worth-while —just as an introduction to the literature that means something—that has been written in the sweat and blood of the great and wondrous of all ages—and whose pages throb with life, and show that human nature is ever the same; that the same hopes, the same longings, the same loves and hates, the same sorrows, and the same bitterness as well as the same contentment and glory have ever been with us all—may it not be that the latter school have some right to their view also?

In the educational world, the two schools may be said to consist of those who believe in "culture" for its own sake, and those who, being more in harmony with their time, insist on "usefulness." The former believe that men and women who have had the opportunities of gathering that which is

best in the world mentally, should form a class by themselves, and by their higher standards and ideals, cause others to follow; the latter, that, as most pupils leave school somewhere around the sixth grade, and but one out of every hundred enters college, our educational system should be made to fit the many, thereby making them better able to cope with their fellows in the economic struggle.

It would seem that the very fact of these two extremes being defended, there might be something said as to a third school, which should attempt a happy medium, and try to give what culture it could, yet not neglect the "bread and butter side."

From a purely reasonable viewpoint, the proper way of overcoming the difficulty would be to adopt something of the German method, and assign the different children to different schools—those who are to enter the cultural fields taking one course, and those who are not, another, but the difficulties attending any *reasonable* adjustment are self-evident in a democracy, for no parent would be willing to say that his sons or daughters attended the "common" schools while his neighbor's attended one of the "cultural" type. And then, further, it necessitates the parent's choosing what career his child shall follow, and should the child himself later have something to say in opposition to the parental idea, the two schools would not lend themselves very well to an exchange of credits for actual work done.

But there may be a slight unbending on the part of both parties, and the new entries into the curriculum are the result of such unbending. French and German as well as Spanish have found a place side by side with the classical Latin and Greek, and the natural sciences with their laboratory work, as well as the vocational studies, have shown us that something quite practical can be accomplished, while

yet holding to ideals that are not low.

There is little objection to the modern languages, but every once in a while anathemas are hurled against the laboratory and the shop; not that these in themselves are bad, but that they do not do the work so well as could be done under trained hands after leaving school and at much less expense, and because the laboratory tends toward a one-sidedness and toward a materialistic bias that is not pleasant for those who look to other ideals.

But it must not be forgotten that to mankind at large the most positive and satisfactory evidence possible, is "to see" —actually to have the thing to be studied and understood, placed before one, felt, and handled, and seen—for with "seeing" and at least one additional sense being brought into service, such as touch, the evidence is supposed to be conclusive, and from that moment the individual's faith in the correctness of his belief is unshaken.

The laboratory has taken advantage of this sensible evidence; in fact, that is the laboratory's justification. It furnishes understandable evidence for the thing the instructor wishes to prove (sometimes, seemingly a great deal more as well, but we are only speaking of the *facts found*, and not the interpretations that may be drawn from these laboratory findings), by actual handling and personal observation. It forces each student to visualize the things studied; to call his attention to the wonderful world that he has daily passed unseen, until his eye has been trained to note the minutest detail; to understand that the so-called big things of life are really but a very small part of life after all, and lastly, it gives him the advantage over an opponent, in drawing his examples and his proofs from actually existing things which he himself has handled, and which by that very handling and the personal conviction resulting therefrom, carry convic-

tion in their turn.

Now, if the only proof any of us are willing to accept is laboratory proof (proof that the senses bring), it needs must follow that for the philosopher as well as the natural scientist, laboratory work is of greatest importance. We are not suggesting, nor are we willing to maintain any such thesis, that the laboratory alone is of greatest importance in the curriculum, but we do insist that it is of the utmost importance for the proper understanding of our modern school system, and for the proper understanding of most of our modern literature.

Laboratory-work means the class-work of the science-student, and the laboratory is but the class-room fitted with the modern equipment necessary for weighing and measuring, for taking apart and analysing the various objects that are to be studied. And by natural science we mean "knowledge gained and verified by exact observation and correct thinking, especially when methodically formulated and arranged in a rational system," [1] or as Professor Huxley put it, "classified common sense." It is the latter definition which will be easier of remembrance than the one preceding it, and it is a sufficient definition for most practical purposes. But the point upon which we wish to lay especial emphasis is this, that science consists of KNOWLEDGE which we have succeeded in forcing from nature by constant and close observation, and that then, *we have taken the facts thus found and through our intellect have formulated them into a system, and read a meaning into them.* So that were the writer asked as to what studies should and must form a thorough background for any scientific training, he would unhesitatingly say that Logic, Epistemology and Metaphysics, after at least a thorough understanding of the "problems of philos-

[1] Standard Dictionary.

ophy" had been mastered, are absolutely essential; for, certainly observation and laboratory-work mean but the *gathering of facts;* then to use these facts in the classification of ideas and thought processes, *the laws of thought and of knowledge must be known.* And if these laws were more often known than they now are, a wondrous mass of hopeless misunderstanding, which results only on account of the looseness of thought, and ignorance of Logic and First Principles which underlie correct thinking, would be obviated.

That these problems of philosophy differ from those of science, but are nevertheless built upon them, as a house of brick must needs have a foundation of at least as solid a material, is self-evident. Professor Hibben well expresses the difference between these studies, and the reader can readily see the necessity for them both to make a complete man, by carefully weighing his words: "the problem of philosophy differs from the problem of science. It is the problem of science as John Stuart Mill puts it, 'to discover what are the fewest number of phenomenal data, which being granted, will explain the phenomena of experience.' Philosophy probes deeper. It seeks to reveal the *raison d'être* of these fundamental data, and their relation to the thinking self which observes them, and reasons about them, as well as their relation to the power which constitutes and directs their elemental energy. The philosopher should be the 'synoptic' man, one who sees the verities of life in their true relations, properly co-ordinated and subordinated, and who in particular pursuits, however absorbing, does not ignore the unity of the whole, nor overlook the universal aspect even of the commonplaces of life." [2]

It is then the duty and the ultimate pursuit of the laboratory-student *to gather facts,* whether to substantiate a new

[2] Problems of Philosophy, by John Grier Hibben (Scribner's).

theory or to break an old one, but *it must always lie with the philosopher who is familiar with the laws of thought* and who, like the general on the battle field, can stand on an eminence and overlook the entire field of vision, rather than with him who keeps his eye glued to the microscope, *to give us the actual results in terms that are meaningful*, though, even here it is most essential that *he who is the general must know the work of all of his subalterns before he himself is competent to pass such judgment.*

It can be said, that any natural science teaches the student the value and the necessity of the *closest observation*, so that no detail escapes him, and *alone can give him that sensible proof* for any statement he may make. This is its disciplinary side and so ranks with mathematics and kindred disciplinary studies.

Now as to the practical value of natural science: we shall take Biology as our example; not because it may be of greater value than any other from this viewpoint, but because embracing as it does the entire study of everything that possesses life, it covers a wider field, and is therefore more applicable to what we are attempting.

Biology comes from the Greek words "Bios" and "Logos." The former meaning "life" and the latter "a discourse"; or as we usually say, "ology" means "science of". So then, we have Biology meaning the "science of life", that is, the study of *all living things, both plants and animals.* In fact the usual preliminary course in Biology consists of Botany (the study of plant life) and Zoology (the study of animal life), while under these headings we have as principal divisions, such subjects as Anatomy (the study of every separate division of the plant or animal body as displayed after death by dissection), Physiology (the study of the functions of the living plant or animal), Embryology (the study of the plant

or animal from the moment of conception until the time it is ready to lead a more or less independent existence as an individual), Taxonomy (the study of classification, so that one may at a moment's notice know how to arrange any new structure found, though never having seen it before), Pathology (the study of diseased tissues), Histology (the study of the cellular structure of normal tissues), Bacteriology (the study of minute plant life), Psychology (the study of mental phenomena), and Sociology (the study of group formation, or social organization).

Probably it will be readily acceded to, that for those who study medicine, or follow similar lines of investigation, a course in biology is and must be of supreme importance; but why should a man who is to become a lawyer or a merchant, or any one of the host of other professions which our complex life offers, spend time in mastering the details (for the whole study is practically a mass of detail-work) of a science which seemingly he cannot use in his chosen work?

The answer is, that as Biology is the study of *all* things living, a knowledge of it is more than essential to a complete understanding of oneself physically and mentally; in other words a thorough knowledge of what Biology can present, means that we have fulfilled the command, as completely as it is possible to fulfill it, "Know Thyself."

All too often we forget that a chosen "career" is but the outcome of what he who makes the "career" happens to be physically and mentally—it is but an expression of his Biological make-up, and surely, if this is true, it means much to KNOW what the study of all things biological can show us as to our weaknesses and our strength in everything we are, or can be. And just as it is the knowledge of his engine that makes a good engineer, it is the knowledge of himself that *makes the man* who makes the "career". Is it any more un-

reasonable then, to suggest to each that he understand himself and know *how he works* (always using our terms to include both the physical and the mental) than it is to have one who only knows how to pull a lever, handle an engine, and suggest that if anything goes wrong, he call the doctor? Is it any more unreasonable to ask a man to know what *not to do*, so as to prevent misfortune occurring to himself, than it is to insist on an engineer's knowledge of what is harmful to his engine and thereby prevent misfortune?

Certain foods do not agree with some people. They learn this from actual experience. This is nature's laboratory method. To experiment on every detail of life would take far more time than is given to any one man on earth, and so instead of using nature's laboratory in this way and working out every detail, great numbers of men work on certain problems for years and outline representative experiments which may be performed by each individual, thereby giving to each a sort of condensed experience of the world's life.

When it is realized that at least one-half of all deaths not due to old age, are caused by plants, namely bacteria, it will be seen that for any one not particularly caring to shorten his life by one-half or more, it might prove of value to pay at least a little attention to bacteriology.

One of the great German materialists said that a "man *is* what he eats" and when we realize that there is very little we eat except salt and water, that we do not get from plants, even though these plants are first eaten by animals and converted into meats, we get some idea of the importance of what the study of plant-life might mean to us.

To the stock-breeder and the animal lover a knowledge of the very fundamentals of life's process certainly must be of value; and to the agriculturist, the gardener, the rancher, or the farmer, the reasons why plants thrive better in one

place than another, the reasons why disease kills crops and prevents the mortgage from being absolved, Biology must readily commend itself.

The merchant whose customers leave him because his supply of meat and eggs are not what is wanted, whose store's appearance prevents the best customers from coming, might quite readily learn the "why" of it all did he become interested in what Biology can tell him in this regard.

The family who has seen one after another of its members droop from some supposedly inherited disease, constantly adding to the list of preventable deaths, might realize what it would have meant to them, had some member of the family known a little about the subject.

And lastly for those who appreciate to the fullest, scrupulous cleanliness, both mentally and bodily, there is some satisfaction in knowing "why" they feel such pleasure.

But Biology has its drawbacks. Taught by those who have had little or no philosophical training; who are incapable of grasping deep and underlying factors which the superficial never can grasp or understand, the great mass of men and women *take only* the *seen*, and forget that "not to see a thing" does not mean the same as "it isn't there." There are a great many things we cannot see that are existent, as is so well exemplified by the fact that when the microscope was invented thousands of objects were displayed to the eye that up to that time had never been dreamed of, and the microscope is very, very far from letting us see *all* there is. Let us not then fall into so crass an error as denying what cannot be seen. Let us rather put it more truthfully and more scientifically, by saying "it has not been seen and that is all we can say".

The unlike training of philosophical and scientific students causes a breach that is difficult to overcome, for neither one

understands the other. Both sometimes forget that there are minds which we might term "legal" whose possessors require an absolute law, definitely stated with no possibility of an exception, or life is by no means sweet and perfect, while to another type of mind, the impossibility of definite and concentrated formulations causes that vague "feeling" that things are as they should be, but, unable to defend these feelings, their possessors cease in time even to care to defend them, and assume that unless another feels the same way, the idea of an explanation is absurd; while men of still another type, realizing their own inability to delve deep and long into a chosen study, and probably too, realizing their own shortcomings in the possibility of making up their own minds when the evidence may appear nearly equal on both sides, insist on authority alone.

We have then, three types of mind to consider, the Legal, the Emotional, and the Authority-seeking, and each of these requires a separate manner of handling. They might all believe and hold the self-same doctrines and yet be hopelessly at outs with each other because the same words carry different meanings to each.

Of the three types mentioned, the average student is what we have called the Authority-seeking. He is inclined to say to himself, that so and so KNOWS and he will ask him. He refuses to do his own thinking. If his physician tells him a thing should be done, he *supposes* the physician *knows*, instead of getting a reasonable explanation, and finding for himself whether the rules of correct thinking and common sense are being followed.

So in the lower school-grades the pupil is very definitely told that a thing is either so or not so, as the case may be. He *is to believe* without questioning. In high-school, some thought is permitted, but not much; in college there is still

a little more broadening out, and some one has said that graduate work is for the sole purpose of learning that the things one's previous instructors had taught were not so. In other words, in graduate work, a man is supposed to have the fundamentals of knowledge; to know the laws of thought; to be able to detect fallacious reasoning, and to be able to distinguish the false from the true, and consequently he is given all the arguments for and against a given problem and has to make up his own mind. Very often he may study with the same master for years and yet not know what are this instructor's personal views on a given subject.

It may be stated that the same person may be of the legal, emotional and authority-seeking type of mind at the same time, or possess any degree of any one or all of them, or in his developmental period may be one for a time, gradually going into one or both of the others, or he may have certain prepossessions on which he thinks only emotionally while using either of the other types of thought on all other subjects.

It may be that one may have been perfectly satisfied with the emotional state, that is, feel content to simply *know* what one *thinks* is so, but being unable to tell others in clear-cut language *why* the feeling of knowledge is there, and meeting some one who has excellent and telling arguments against the idea under discussion, the individual being unable to defend himself, realizes that there is something, after all, in the legal type, and then and there he would give much to be able to tell exactly *what he feels and why he feels it.*

It may be that one of the authoritative type may have the utmost confidence in one *whom he thinks knows,* but finding the "knowing-one" unable to cope with an adversary, sees all foundation taken from under his own feet, and then he faces the interesting and perplexing question of who is

to be his authority, for having found himself wrong in the one case, how can he tell he will not be wrong again?

Does it not all revert back to the legal type? To the one who KNOWS and KNOWS THAT HE KNOWS and can definitely and in understandable language give a reasonable account for his beliefs?

And should one be of the legal type, or ultimately become so, and further, should one likewise desire consistency in the search for truth, one must try to find some First Principles, for one cannot build without building material, and First Principles are the first things we must have in order to be able to do any thinking or any constructive work whatever. Of course, we cannot find any First Principles or first causes in Biology, but we can find material on which to build a first cause; after all, we have to speak and think in terms of the sensible—and sensible things are those that come under the senses—laboratory evidence.

So, then, as far as we know, spirit—or life—never shows itself except through some bodily form. Every thought we have must be based on physical experience—that is, there can be nothing in the mind that has not got there through the senses. We find that different states of the body seem to affect our mental state, such as when we have been working arduously we cannot think clearly, or as a philosopher has said, "One cannot hoe cabbage and philosophize at the same time". And yet there is a very large school of men who deny even this, that the body can have any effect whatever on the mind or the mind on the body. They have very many good arguments to sustain their views and they draw them largely from Biology. The opposite side also draws its arguments from the same source, so that, it is absolutely impossible for any one accepting either side of the argument to be able to defend his own view or legitimately to find flaws

in the opposing one, unless he is familiar with the very fount from which both sides have drawn their evidence.

If the view is correct which many hold, that the ultimate beginning of things is wholly independent of any spiritual cause, and is simply the mechanistic working out of some fundamental substance, then the support for those who contend that there is such a thing as absolute right and wrong is withdrawn. In other words, if to obey the ten commandments, for example, is right, because a Supreme Being has given them to humanity, if there be no Supreme Being, quite naturally He could not have given any commandments, and no commandments having been given, it is absurd to assume the obeying of something which doesn't exist, is or can be right.

This chain of argument could be followed out indefinitely, but the point to be made is simply this, that the viewpoint of many very able men is materialistic, the reasons being, in all probability as Dr. Martineaux suggests, that as long as our education is one-sided, and men are more under the influence of the seen than the unseen, this condition will continue to flourish; but that does not change their view, and if one wishes to feel positive that one is right, it is most essential that a defense can be given to all one's beliefs, and no matter to what school a person belongs, if he wishes to do this he must know something about the natural sciences, and preferably some of the laboratory work of Biology.

If then, Biology is so far-reaching, that with it, and upon its findings we may apparently destroy every vestige of our reasons for morality, as just shown in the downfall of the theory of right and wrong; if the only evidence we accept in proof of any theory is laboratory evidence; if every act that is done, every plant that is grown, every thought that the mind can hold, every impulse that nerve-arcs may bring

forth, every movement we may make, every disease we may have, every emotion we may feel, comes under the study of LIFE, and if Biology is the Science of Life in all of its many manifestations, is it not worth our study?

CHAPTER II

PSYCHOLOGICAL LABORATORIES

THIS chapter aims to do three things and only three, and these are to be treated as briefly as possible, consistent with clearness and simplicity.

It aims to give a short survey of why men's interests have gone from the problems of the mind to the gathering of observational facts; to show some of the practical aspects of Modern Psychology; and lastly to point out that it is Modern Psychology that may yet prove the *via media* by which the thinker of to-day may be brought back into his own, while yet not lessening the standing of the sorely needed observer as well.

It is of the utmost importance that the distinction between observer and thinker be thoroughly understood. The former attempts to find the actually existent and to describe it, the latter, too, is interested in all things that actually exist, but this is not *the end* he has in view, for, to him there are REASONS for all things, and his end and aim is to find those reasons. It is so often the case that because some one has described something, that many assume that it has been explained, but the difference between a description and an explanation is too self-evident to escape any one who will give the matter the slightest attention.

To be an observer, then, requires a vast quantity of patience and accuracy. To be a philosopher requires likewise these accomplishments, but in addition thereto, one must have the ability to detach oneself from oneself and to think

not only of the facts found, but to think of one's own thoughts; to analyse, to classify, and to see the vast mass of thought in its relation to everything else connected with it. *It requires sustained mental effort.*

And it is right here that we cross the line of demarcation that separates knowledge from wisdom. The knowing man is he who accumulates a quantity of facts; the wise man is he who knows how to explain them—to fit these same facts in their respective places accurately and well, and who can then tell *why* they fit in those particular places and no other. In other words, the former seeks to perceive as much as he may, the latter to tell what it all means after the perceptions have been gathered.

The wise men of the ancients were philosophers; the thinkers of all times who have changed the course of thought on this earth of ours, have always and ever been philosophers. President Hibben of Princeton University means this when he says, "The standards of every age, individual, social and political, have been modified to a greater or less extent by the influence of philosophical discussion. The doctrines of the schools become at last the maxims of the crowd. The eighteenth century philosophers cannot wash their hands of the blood of the French Revolution." [1]

Bearing in mind that for over three thousand years the wise man—the great man—the really worth-while man—was the philosopher, it is interesting to note what causes brought about this change and why only during the last century men have turned from the realms of philosophy to the realms of perception. But even though this change of interest be a fact, we must not forget that *the value of the thinker* is no less among the learned, nor has it ever been, but it is only to mankind at large, untrained to note fine distinc-

[1] Problems of Philosophy.

tions, that the philosopher has come to be almost an unknown figure.

There must be a reason for this, and we infer that it is probably due to the rapid increase in the number of schools taking place about the same time that the microscope, telescope and other revolutionizing instruments were being perfected. There are so many things in this world of ours—our interests are so varied and so multitudinous—that such an instrument as the microscope, offering as it did, the excitement of new discoveries—of findings that men had not even dreamed of—brought forth such a host of investigators, who constantly sought for new wonders with which to astonish the world. The many new schools that were opening in all parts of the world found, that to be abreast of the times they must needs install one or more of these investigators. Students who being unable to sustain the strain of constant philosophic thinking in the abstract, and having been brought up amidst surroundings that led to no thought of anything except the material, knew not what "soul" or "spirit" meant. To them there was only the "seen world"; this alone was real. Three or four generations of such training and always we shall have the same result. Men became accustomed to the evidence of the senses and would listen to nothing else. All must begin with the senses. Philosophy had not yet had time to manage itself and adopt the new terms, and the excitement was so intense, that it probably would not have mattered anyway, at that time.

But starting with the senses was the way the thinker had always begun. The philosophy of the past had always insisted that there could be nothing in the intellect that did not come through the senses; but the new men in the field of observation used the terms of the past in so totally a different way that he who knew philosophy could no longer converse

with a colleague in terms that meant the same to both, and so it became necessary for the philosopher to step down from his century-old throne and walk far afield in order to bring back those who had strayed from their ancient home. He had, and still has, to use the most commonplace examples, to make his thoughts understandable to the observer. But what cared the observer for abstract thought? He was an explorer on the then great unknown sea of minute observation and he was ever finding something new with which to astonish the world and bring to himself enconiums and emolument. The world was at his feet; men wrote of him; spoke of him; honored him and above all paid him. But, just as the individual becomes tired when kept at a task too long, so, too, does the race. And when volumes had been given man with one new discovery after another—when the eye had told us what could be seen here and there when magnified from a hundred to several thousand times—the question formulated itself—well, what of it? We admit what you see; what you say may be there, but what of it?

It was the old, old yearning implanted in every man to feel a conviction that the things he says or does actually *mean* something. What of it? We had gathered thousands of facts and now we wanted to know what was to be done with them. That became a vital question.

The great wave that carried upon it so many men into observational fields quite naturally carried with it also a few, who, having broken loose from their anchorage in the thought of the past, and who, having had the philosophical training which bound them to that past, could observe and interpret as well. To these men we owe both the good and the bad that has had any lasting influence in the scientific world. Trained as they were in the laws of thought, they were often wonderful logicians and carried out their thoughts with an

inexorableness that is more than marvelous. But we must never forget that logic teaches us only the *rules* of correct reasoning. It does not guarantee a true conclusion. It only guarantees a correct conclusion from the premise originally adopted. That is, one may come to a very erroneous conclusion, but be perfectly correct in one's reasoning, because the thing with which one started was incorrect.

Starting then as did these men, with many and many a premise that we have since learned cannot be substantiated, they built up logically a wonderful edifice, all of which has crumbled into dust because the foundation upon which they built has been demolished by later investigators.

This is then a short sketch of how and why the great changes we are recounting, took place, and why it is, that now, no matter what our subject may be, aside from the First Principles of Knowledge, we must produce laboratory evidence for anything we wish to have accepted, for it is still true that the great mass of students in our colleges and universities receive practically no training whatever in the grammar of thought, Logic, but are let run loose over the entire intellectual field without a single law to guide them. Is it to be wondered at that so many absurd theories are afloat?

Now, philosophy means to love wisdom and a philosopher is one who loves wisdom, and "the problems of philosophy are really the problems of life, the burden and the mystery of existence, the origin and destiny of man, the relations which he sustains to the world of which he is a part, and to the unseen universe which lies about him. Though they may not be couched in philosophical language such questionings of heart and of mind we cannot wholly silence." [2]

And one of the greatest branches of philosophy—the one

[2] Problems of Philosophy.

solving the great problems of the mental world—is what we call Psychology; the "science of the soul" as it was originally called by the Greeks, but which we now call the "science of mental phenomena." Again it will be observed that there is an attempt made to bring down the realms of the unseen to the laboratory. The "science of mental phenomena," meaning nearly always the actual seeable and hearable—in fact, all sensitivity that can be studied in the laboratory.

Not the thing that is behind all sensitivity; not how and why we have this sensitivity; not what it is for; but what can we bring under the senses and then what theories can we advance on our findings. This is what we mean by saying that the philosopher has had to go far afield to bring back the wandering son.

It is upon Psychology then, that philosophy largely rests, for certainly if there be no "mind"—that is, no thinking self—we could have no philosophy at all. So nearly three thousand years ago the Grecian sages saw with their "mental eye" that there was something beyond the physical alone. They realized that the physical eye could but throw an image; that the object itself at which one looked did not enter the eye—only the image did that. They found that more or less rapid movements of air were converted into sound when the ear was normal, and they set about trying to find why this was so.

This was the birth of Psychology, as a defined part of Philosophy, but what we now qualify by calling Rational or Philosophical Psychology. It merely tried to explain through the process of reasoning and not by experiment, and this method has come down to us through the ages, honored by the greatest minds of all times, and still dominating the great mass of men and women. But, while experimentation has not

been able to overpower reason, the methods of the past have fallen into neglect and so we, who place reason on the highest pinnacle, must experiment, in order that the truths of the past doctrines may not be lost. Men do not often accept *a priori* reasoning now. They want *to see* the evidence. They cannot sustain the great mental lengths of the past and reason it all out. It must be placed before them in as simple a form mentally as we explain physical things to the infant, so that some have thought that by actual non-use of our reasoning powers we are as a people, descending in the realm of the intellect while ascending in the realm of the application of the things we do hold.

And so Modern Psychology, or Experimental Psychology, or Physiological Psychology, all meaning practically the same thing, was born in the laboratory. It should rather be said that the laboratory was its mother and insanity its father, for if, as Dr. Henry Smith Williams contends, Modern Psychology was born in the year 1795, when Dr. Pinel removed the shackles from the insane in Paris, and if, as will be observed in his statement of that event, all the past was to be heartily condemned, we can read into it all, it would seem, the ideas of one who is not very familiar with either what the past stood for or attempted, but whose view, nevertheless, is the prevailing one; he says: "And so it chanced that in striking the shackles from the insane, Pinel and his confreres struck a blow also, unwittingly, at time-honored philosophical traditions. The liberation of the insane from the dungeons was an augury of the liberation of psychology from the musty recesses of metaphysics. Hitherto, psychology, in so far as it existed at all, was but the subjective study of individual minds: in the future it must become objective as well, taking into account also the relations which the mind bears to the body and in particular to the brain

and nervous system."[8]

If the laws of Genetics mean anything, we know that the offspring of one or both parents who are insane, may be and usually are far from sane, may it not be possible to apply these same laws here and suggest that if insanity was the father of Modern Psychology that that accounts for so many near-insane applications suggested or ideas promulgated by insufficient experimentation and almost half-witted evidence? But we must not forget that the working out of the same laws which may render men dead to one sense may also increase another faculty and make him a genius, and so, too, from this experimentation during but a comparatively few years we have obtained benefits that mean more to us and have a more far-reaching effect than many of the thoughts we have been quarreling over for centuries.

It is in this abnormal field that we have found so much that throws light on the normal, so that for any one desirous of knowing anything about alienism, it is absolutely essential that a knowledge of both normal and abnormal psychology be thoroughly mastered, notwithstanding that there are those who contend that the mind is but the sum-total of the expression of the individual's entire complex life, and does not exist at all as such; and that the mind is but an emanation of the brain and nervous system as the light is an emanation of the match, so that one writer has said that the mind can no more affect the body nor the body the mind, than a piece of "beefsteak placed in a sausage machine" could be expected to come out a moonlight sonata. And crass as this statement appears, it is the conclusion to which one must come if he accept the parallelist doctrine that mind and matter are totally and constantly inseparable functionally.

[8] The Century's Progress in Experimental Psychology, by Henry Smith Williams, M.D., Harper's Magazine, September, 1899.

To this the interactionist demurs. He acknowledges that both are found side by side, but does not believe that one can thereby argue that the one cannot influence the other. The proof for this latter viewpoint seems to be with us in our daily experience, so that even the parallelists, as Professor John Watson of Johns Hopkins says, use language that shows they think in terms of interaction, though speaking and writing in terms of parallelism.[4]

Now what was it that the abnormal field gave us that is of so much importance as not only to lead to more than wonderful results as shortly to be recounted, but which again led men back into the realm of the mental from which they had departed, seemingly for all time?

First, it was through observation, especially by aid of the microscope, that it was found that the two pairs of nerves attached to the spinal cord and leaving it between each vertebra were two pairs of dissimilar nerves as far as function was concerned. The two anterior ones being motor and the two posterior, sensory. That is, the anterior-nerves never carried any impulse except from the spinal cord to some muscle of the body and the posterior nerves only carried a sensation from some part of the body to the spinal cord. Here probably was born the idea that every nerve in the body had a definite function to perform and could perform no other. Up to this time, also, the brain was considered more or less a unity of tissue. Now it was found that there were millions of cells in the brain and still later that each cell of a nerve in any part of the body had several processes, but it took a long time with wonderfully contrived methods to find where these processes ended and what they did. One of the very important discoveries along this line was that

[4] Behavior, An Introduction to Comparative Psychology, by John B. Watson.

when a nerve was cut in any way, the part between the injured portion and the outside of the body would cease to function and would degenerate, while the part extending from the cell itself would often grow again.

It was only by this process of degeneration—by cutting various nerves on the smaller animals—that the degenerated part could be followed completely and the entire course of the nerve discovered.

Next came the finding that no nerve connected directly with another. Usually the end of a nerve running toward the spinal cord had a tiny arborization that surrounded another nerve cell, but did not come in actual contact with it, and then came Ramon y Cajal's theory of how the nerves function, namely, very like a telephone system, and just as each cell is stimulated and acts, it extends one or more of these little processes and really reaches out and touches the cell or processes of the cell to which it is to carry its impulse.

But of greater value than these discoveries is the one which has meant so much in the practical field, and which is so well and succinctly put by Dr. Stephen Smith, himself a man who has done more to effect the banishment of cruelties from the insane in this country than probably any other man. He says: "The lessons which the illustrations of the anatomy and physiology of the nervous system teach have a wide application to our treatment of the dependent classes. We learn that the mental attributes of every person depend ultimately upon the physical state of the cell, over which we have almost absolute control both in its individual and collective capacity. If its texture is feeble from heredity or disease, we may make it strong by nutrition, exercise, pure air, and medication; if it is undeveloped, we can develop it by applying appropriate stimulus and suitable nourishment; if it is unduly

developed and hence overactive, we can reduce it to a rudimentary and inactive state by removing every form of stimulant and reducing its nutrition; where neither the regulation of the stimulant nor nutrition accomplishes our purpose, we can rely upon specific remedies.

"The logical and inevitable conclusion to be drawn is that, if we thoroughly understood the exact function and the functional relations of all the cells of the nervous system, we could, beginning with the child, control in a large measure the development of his character, and in the adult modify existing attributes by stimulation of one class of nerve-cells and the repression of another to any extent that we desired. Nothing can be more thoroughly practical than the application of the proper remedial measures by which the equilibrium of these centers is secured." [5]

It may be argued that what we have discussed is Neurology and not Psychology, and this is perfectly true; but as "mind," in so far as we know it, does not work in the human sphere except encased in the body, so, having by common experience since the beginning of time found that the diseases of the body do affect the mentality, and having further found that the highest center of mentality, the brain, is especially affected by nervous diseases, and still further having found that the brain itself, the organ of intellection, is a mass of thousands of millions of tiny cells, each with its own nerve-processes that may and do connect with others, we find we must have this neurological setting for any thorough knowledge of the mental processes. We do not by that become neurologists, but we do wish to know all the neurologist can tell us, that will aid in the better understanding of WHY a mental reaction is what it is.

And so the psychologist of the present works upon this

[5] Who is Insane? by Stephen Smith, A.M., M.D., LL.D.

background of biology and neurology by tracing from the earliest beginnings the marks of sense perception and the peculiar reactions that animals give when various stimuli are applied, under the heading of *animal* or *comparative psychology*, both for its own sake, which is the mark of the true scientist, and for the practical effect it may have in throwing light on the processes of the child especially, and this is what we call *genetic psychology*, so insistently studied by those aiming to teach, and which has already done so much for the growing child. No longer is every child considered the equal of every other and all treated alike. We are trying to get away from the machine-like pattern of similarity and getting to look at each as an individual, so that many of the larger private schools have their *consulting* psychologist who measures the ability and intelligence of each child and classifies him accordingly.

We have through this study become better acquainted with the psychology of learning so that we know much more now than we did a few years ago as to the better method of learning more thoroughly and in less time than formerly. We have found the diurnal movement, for example, that passes through the nervous system and makes it easier to remember two days after a thing is learned than immediately after the task is completed. And in line with this, an interesting sidelight was thrown on the differences in the working of normal and subnormal children in London, where Mr. Philip B. Ballard performed a great number of experiments on school children ranging in age from five to fifteen years, and found that the subnormal child could remember very much more after some time had elapsed than he could at the moment of finishing the memory test, while the normal child knew more than did the subnormal at the time of learning, and not so

much later.[6] This might be interpreted that it was not less ability on the part of the one than the other, but that there was a difference. The subnormal being slower in the procuring of his memory work but greater in his retention afterward. And it may be that the very reason for the child's being considered subnormal was merely due to the longer time it took him to memorize. Should this be the case, as it no doubt has been time and again, it may be found that many of our greatest men, who had to study hard and long before they were able to grasp the subject at which they were working, but who then never forgot it, were classified by their teachers as below the standard and not of much value.

Under *social psychology* we study the "herd instinct" as it is often called. The desire of men to live with others and form a community. In other words it is the study of genetic psychology taken from the individual and applied to the nation or group, while under *racial psychology* we go still farther afield, gather the myths, the superstitions, the beliefs and the forms of worship of all peoples and try to co-ordinate them, and weave them into a meaningful whole.

We have a *psychology of history* and a *psychology of religion*, both of which are more or less self-explanatory, while in the practical field the best known is probably *applied psychology*, which usually and largely means *advertising*. That is, to find what methods are best to attain the ends one wishes, through newspaper, magazine and salesman. In fact the commencement and successful operation of scientific-salesmanship schools and the great number of industrial houses which now have departments of training for their men is a direct result of the interest in applied psychology.

And then there is another psychology, which has not yet

[6]Obliviscence and Reminiscence, by Philip B. Ballard, M.A. Vol. I. No. 2, British Journal of Psychological Monograph Supplements.

been given a name except that it has been called "sex psychology," though this does not label it exactly as it should be labeled. We refer to the mental differences between men and women. It is through experimentation that we are seeking to find what differences actually exist mentally between the sexes, and whether they are fundamental or whether they are due only to different methods of training.

The writer has taken some eleven thousand mental measurements of men and women and has found a seeming similarity among women of their dislikes, but they do not agree so well on what they like, whereas the reverse can be said of men, they usually agreeing on what they like but have very varied dislikes.

But throughout these experiments it was found that always the great mass of both men and women agree somewhere near an average, that is, the thing nearest like to the things with which they are familiar or which are not too original, are admired most. Great originality does not come in for many enconiums.

And always one can see the predilection and prejudice under which the person is laboring, for it almost always shows in his judgment; very, very few passing an opinion solely on the merits of the case.

And most interesting of all the experiments is the one that compares the judgment of a single individual given many times on the same subject with the same number of judgments passed once by a number of people, for the individual differs more from his own judgments than do the many from each other. In other words, a jury of fifty people would pass a more correct opinion than would one individual passing an opinion fifty times on the same case, provided, always, of course, that it could be passed on such matters where memory would not enter. The experiments here mentioned

were performed only with the sense of touch and sight.

One can readily see that here we have a very vast field in which to work and many interesting and valuable findings may be made.

Then there is a psychology for medical students; for legal students; for engineering students, and in fact for every walk of life. But of all the branches of experimental psychology, the most far-reaching in its practical results is in all probability that of *abnormal psychology.* Within this field may be found actual and definite results, immediate relief, and often cures in thousands of otherwise hopeless cases. Heartaches have been removed and many subnormal children have been trained until they can hardly be distinguished from many persons not so unfortunate. Schools for training them have been established and successfully carried out. It has taken intelligence, and constant fighting to overcome obstacles and opposition to the suggestion that the feeble minded could be made self-supporting. But success has been demonstrated. Psychopathic hospitals and institutes have been opened where those who are committed for various offenses by the state may have intelligent care and attention, and often be made into most excellent men and women, for, often the original reason for the fall of these people has not been an inherent evil disposition and desire to commit wrong, but an entire lack of training which made them incapable of knowing what right and wrong meant.

A systematic classification of the idiot and feeble-minded has led to excellent results and better care; and a knowledge of the ultimate material product of our bodies, the cell, as the lines before quoted of Stephen Smith so well exemplify, has led to an attempt, proven more successful than even the promoters had dared to hope, of not only helping, but actu-

ally bringing back to sanity by proper training of the nervous system about twenty-five per cent of all commitments to insane asylums, and there is little doubt that when all the states realize, as some of them do now, that not a physician should have charge of these homes, but an alienist, thorough in his work, who puts into practice the findings of the other members of his staff, consisting of a physiologist, a pathologist and a psychologist, that this twenty-five per cent will be materially increased. The last three members of the staff, mentioned, are research men who discover the laws and the reasons for these laws, while the alienist puts them into practice.

And in the field of criminology our eyes are opened when we make mental tests of a whole series of so-called criminals and find them rated by our tests as averaging from eight to fifteen or sixteen years in mental age, regardless of what their years on earth may have been.

It is no small thing for one science to be able to point out that it has revolutionized several others and those very ancient and important studies; it is no small thing to be able to say that this same science has restored many, many to their reason from supposedly hopeless insanity; has made self-supporting men and women where there were only dependents before; it is no small thing to have taken the shackles from the insane and the convict and to have helped remove cruelty in the world in those places where it was most practiced and mostly thought necessary. And lastly, it has, through its acceptance of the laboratory; through its use of physical evidence, from which it then draws its conclusions, brought back many, yes very many, to a realization of the fact that after all, life is not all material, and the spiritual also is there. It has been and is a sort of connecting link uniting the materialistic biologist of the present

with the spiritual philosopher of the past, drawing them closer and closer together, exposing the crass mechanism of a day happily past, showing a prospect of hope and glory, that in so far as it has already had so glorious a history during the few decades of its existence, may yet lead to greater things and make the name of psychology shine forth where it belongs, as a necessary star in the constellation of all that is good and true in the world of learning, and as the one connecting link which unites the observer—the gatherer of facts—with the thinker—the philosopher—the interpreter thereof.

CHAPTER III

GENETICS

GENETICS is the study of the origin and development of everything and anything that may throw light upon the child. It is the study of heredity and development of the infant. It aims to collect every fact, whether it be anecdotal, observational, statistical or philosophical; then to take these facts, segregate them, study them in turn, and finally to interpret them for the same reason that one gathers and interprets facts in any science, namely *to control and prophesy.*

There are two great viewpoints from which this new science may be considered, namely, the Biological and the Psychological. The former takes into consideration primarily the pre-birth state. It aims to ascertain reasons why children are born with the particular equipment they possess, both quantitatively and qualitatively.

As scientists and philosophers have always known that men are not born equal, it develops upon the Biologist to ascertain WHY, but from the *physical* side only—the assumption being that with a good healthy body the psychic part will care for itself.

Little progress had been made in this field, because men had found no laws of heredity which could be applied in even a majority of cases, much less in all. The methods of investigation were really not investigations at all, but simply collections of what is known as anecdotal evidence; that is, some one observed or thought he observed one or more cases

of a given type without knowing any of the details of that case, or the reasons for the individual's being as he was, and by hasty generalization (the bane of all scientists) formulated a theory which gained sway among friends and disciples of the theorist. It never seemed to dawn upon the pronouncer of the theory, or any of his disciples, that fifty per cent of the results of any suggested theory is more than likely to be true if there are only two alternatives, or if more, the same proportional truth will find its way, even in an erroneous theory. So that, so far as evidence (sic) is concerned, there is no theory that cannot find such proportion of substantiating facts as we have mentioned, and which is called *chance*. What is needed, however, is *much more than chance*. We must find, let us say, more than seventy-five per cent of the cases under consideration showing the thing we are seeking, or our theory has little or no value.

Prior to the nineteenth century, men working in the natural sciences, especially in Biology, were more interested in trying to find a definition for each separate thing which should show a reason for keeping it apart from some other group or individual than they were in finding a relationship between them. Let us give an example. The interests of scholars of that day lay in trying to define *species* so that the definition would be *exclusive*. That is, they tried to lay down a rule saying that everything that had this or that feature, belongs to this or that species, and everything that does not possess the peculiar characteristic in question, was simply to be excluded; so that, should there be found so strange a creature that might possess one-half of both the necessary features of two separate species, that particular creature was doomed not to be studied and classified but mercilessly to "perish beneath the boot-heel" of the investi-

gator as an anomaly, and therefore was not to be considered. He was a disturber and should be cast into the darkness.

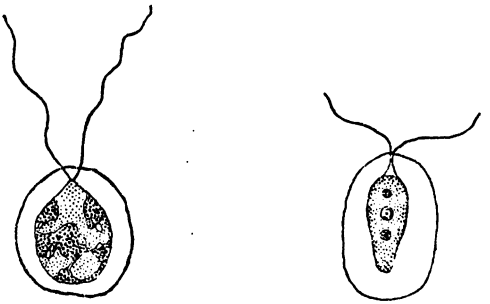
The reason we now begin evolutionary discussions with Lamarck and Darwin is because they reversed this order. It is not because of the theories of these men particularly, for the theories of both are largely discarded now, as will be shown in our chapters on "The Present Status of Evolutionary Philosophy" and "Theories of Evolution," but because after their time, there was a change in the old order, men then insisting that the important subject for study was not differences which kept species apart, but similarities which showed a relationship. This opened up an entire new world of thought, and no doubt some of us, after seeing some of the things it brought forth, think that it might just as well have remained unopened, but be that as it may, the fact remains that we are now no longer interested in the lines of exclusive but of inclusive demarcation. Now we want to know why it is that nearly every bird and animal is a pentadactyl, that is, why they have five fingers and five toes; in birds the fingers being represented by the divisions into which the wings fall. These are clearly discernable in such wings as those of the bat and many birds as well; while in some types of birds we find by close examination the several fingers have grown together, the bones however showing a sort of separation. We find this same condition in the various types of animals. We want to know *why* all these living things are so much alike, and not *what* differences keep them apart.

Botanists claim certain minute organisms as plants while Zoologists claim these same organisms as animals.[1] If it be possible to have a living thing so closely resembling both

[1] Hæmatococcus, for example, a little single-celled organism, containing chlorophyll (which is the usual test of whether the individual be

plant and animal, that men who spend their lives in the study of just such matters cannot even decide on whether to call it a plant or an animal, one can easily see what a vista is opened to those of speculative inclinations.

And from this gradual seeming rise of the plant and animal in the scale of worth, it was easy to assume, because new things were daily being found by the aid of the microscope, that there must be still smaller things than the lowest forms of plant-life which would unite the living and the non-



Hæmatococcus—Motile Stages (after Parker).

living. This is one of the assumed purposes of the bacteria. And again there came forth the theory of spontaneous generation—that we might be able to take a small quantity of hay, for example, boil it until it was completely sterilized (and therefore could contain no life whatever), then permitting it to stand, actually see it produce life. This was a fascinating doctrine and when investigators announced that this had been done there was great rejoicing in the materialistic world. However, it was but a short time thereafter that other investigators taking far more care than

a plant or not) and possessing flagella (little tails by which they move about). These are often included under the Algæ or lower green plants. (See Parker and Haswell's Text-book of Zoology. Vol. I. Page 72.)

had the first to prevent the intrusion of living organisms after the sterilization, found that no life was so produced, and at the present moment there is no investigator or biologist who will admit that spontaneous generation has been demonstrated in the laboratory and the great scientific formula now universally accepted is that there is "no life except from a previous life" and "no cell except from a previous cell."

As all things have their cycle and ultimately come to a close, *the origin* of *species* ceased to hold men's minds in thrall as it had during the last half of the nineteenth century, and a great body of men drifted into specialization of one or another of the many branches of natural science. There were in a short time investigators of the nervous system—Neurologists; of the general structure of the body —Anatomists; of the development of the individual before birth—Embryologists; of the plant world—Botanists; of the animal world—Zoologists; of mental phenomena—Psychologists, and a host of others. This will but serve to show the possibilities of the subject. And then there had to be a co-ordinating of the findings of all these individual workers. Each one found something unknown up to that time—each interpreted his finding in the light of his own individual knowledge and viewpoint, only to find that in some other field of endeavor the opposite conclusion could be reached and often was reached from just as thorough evidence.

So that now, with a vast body of facts in our possession, the principal matter under consideration is to find *correct meanings* for these facts, always considered in the light of *all the knowledge in all related subjects.*

We find then, that the interest is no longer *primarily,* in the *origin of species,* but in the *origin and development of*

the individual. This subject, too, has had its devotees in all ages, but we of the present insist on *laboratory proofs* if we are to credit the many theories propounded. We are not interested in what Edison thinks about *heaven*, as several newspaper men of a few years ago thought, but we are interested in any definite laws he may have discovered, or proven, that may be used by all. It is for this reason that an inventor is not a scientist. He does not discover laws that others may profit by—he *applies* the laws of men who have found them, and these latter,—the ones who found them, are the real scientists.

There was a man, some years since, who received no title of "Wizard"; who lived in a little village in Austria during all of this great period of scientific upheaval which we have been discussing and who died some thirty years ago; who was not even known outside of his immediate province and hardly known there until some years after his death, but who has profoundly influenced the whole scientific world. It is safe to say that in the Biological realm there is no name that ranks superior to that of Father Johann Gregor Mendel, of Brünn, Austria, of whom Castle has said: "Mendel had an analytical mind of the first order which enabled him to plan and carry through successfully the most original and instructive series of studies in heredity ever executed."

Mendel followed out the principles insisted upon by every experimentalist, namely, that he perform his experiments under similar conditions that may be controlled, and then definitely record his facts.

His great work consisted in the scientific breeding of peas.

The theory now known as the Mendelian would require entirely too much space for a book of this nature, were it to

be stated in all its fullness, but should the reader become sufficiently interested to wish to read further, he will find in the chapter on "Suggested Reading" the names of the volumes which will give him a complete and comprehensive account thereof. We shall state here only so much as is essential to an understanding of what follows.

Mendel found that by crossing tall and dwarf peas, regardless of sex, all of the offspring were tall. Tall, breeding in this way he called DOMINANT, while the dwarfness was labeled RECESSIVE. Further, he found that when any of the peas were crossed with each other or were self-fertilized, which amounts to the same thing, they would produce in the proportion of 3 to 1. That is, the dominant type (tallness) would have three plants to every one of the recessive (dwarf). On still further breeding, the dwarf peas would always breed true, which means that there would never again appear a tall one among them; but among the tall plants there were two kinds—one-third of them always producing talls, and the other two-thirds, known as hybrids, giving a proportion of three tall to one dwarf, like their parents.

For our purpose it is necessary that we remember one thing in particular; the second generation where *all* were tall, had inherited one-half of whatever they were from their mother and one-half from their father. *Tallness was dominant, but we must not forget that dwarfness was also there, but covered and dominated by the tallness. There was no blending.* The offspring were not intermediate between the two parents as to height—they were either tall or short. Another point to observe is that in the third generation some were short and some tall, but, that notwithstanding this fact the short ones always bred true thereafter and one-third of the tall ones did likewise. The supposition

being that in the original fertilized germ-cell the tallness is present and is dominant; so, if the germ-cell of its mating partner is likewise tall, there will always be tall offspring which can never produce a dwarf, while if tallness meet with the germ-cell of dwarfness, tallness being dominant, tallness will likewise result, but with this difference, that the dwarf character is also there, though lying dormant for the time being. As each plant produces a great quantity of germ-cells and an egg-cell is only fertilized by a single sperm-cell, if the sperm-cell is of the dwarf type and mates with an egg-cell of the same type, we have a dwarf as the result. In other words, each plant produced—if a hybrid—both tall and dwarf types of germ-cells, and if any egg-cell becomes fertilized with any sperm-cell of its own kind, it naturally produces its own type, and if not, it produces tall;—*but*, the tall which has met with a tall, always breeds tall and the tall or dwarf which has mated with its opposite type also produces tall, but the offspring of the next generation may be either tall or dwarf depending upon whether it be a pure egg-cell mating with its own or its opposite type, and so on *ad infinitum*.

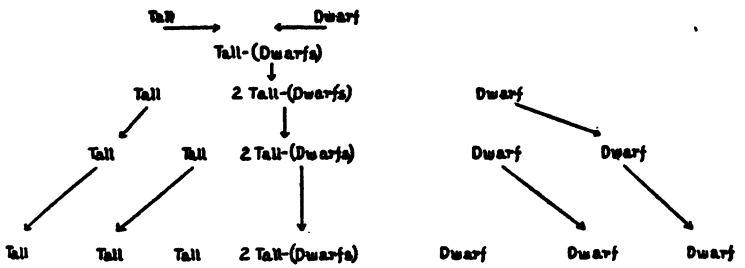
This, as will be observed, is based on the law of chance, for, as we have shown, any events allowed full and uncontrolled sway are bound to result in appearing one-half the time on one side and one-half on the other, if there be but two alternatives, and proportionately, should there be more. In this case we have *four* alternatives, and only four:

A tall may meet with a tall.
A dwarf may meet with a dwarf.
A tall may meet with a dwarf.
A dwarf may meet with a tall.

This sketch shows the possible occurrences in the mating of dwarf and tall, graphically. Tall meeting tall and dwarf

with dwarf are what is known as "pure," while dwarf with tall, and tall with dwarf produce "hybrids," these hybrids, however, *are all tall*, but *capable of producing both tall and dwarf offspring*. One-half are pure, it will be observed, and one-half mixed—showing this law of chance of which we have spoken.

And now we may suggest the great usefulness to which the Mendelian theory may be put. We can, in advance, if we know one or two generations of ancestors, be able to foretell



the ratio of the appearance of what is called a "unit of inheritance."

We have been speaking primarily of one characteristic—tallness, or the lack of it. This tallness we shall call one unit. It is, of course, possible to complicate matters by taking two units. We may take a green wrinkled pea and a yellow smooth one and from this combination produce a yellow wrinkled one and a green smooth one. Having four factors we should not, however, have four possibilities, for we found four possibilities where only two factors were present, so in this case we have four times four possibilities

appearing and so on, with each increase in the number of factors.

The difficulties and the immense number of possible combinations which may occur in the human form with the hundreds of unit characteristics may readily be inferred from this. But to show what has been done, so we may not be discouraged with what the future may hold for the science of Genetics, it is possible even now, to predict the ratio of children with curly hair; whether it be light or dark; the color of the eyes and whether or not color-blindness will appear. These are, of course, but minor examples to show what is meant by the prediction of the appearance or non-appearance of unit characteristics.

Father Mendel's work has turned all eyes to this great principle of chance with its dominant and recessive characters, so that now we have untold numbers of investigators in the various fields of heredity, experimenting, searching, gathering evidence and interpreting it. In the plant world especially has much been done, and we have the Botanists to thank for the greater part of our knowledge on the subject. Then the similarity of plant and animal world and the impossibility of telling where the one ends and the other commences, causes the application of the same theories to the animal field and to the human; for after all, aside from animal and plant-breeders, the greatest interest lies in whether or not we can, by intelligent forethought, cause the child to be better equipped at birth than he now is.

We mean then, by Genetics, the study of the Biological and Psychological inheritance and the development to maturity of the offspring in all the world of life, but especially as applied to the human child. And every fact that can be brought to bear upon a subject so vital—of such concern to every teacher—every parent—and every indi-

vidual who has, or ever expects to have anything to do with children—needs to be considered. It is the study of Individuality as contradistinguished from the study of Species.

From the biological standpoint then, the great outstanding factor is this, that "Structure determines Function." We cannot perform any act whatsoever, unless we have an organ with which to perform it; but we must not forget that Function in turn modifies the Structure, as we can readily see in the massive muscular development of an athlete.

From the psychological point of view so simple a thing as looking at a printed word and reading it, is a very complex process, requiring not only the image thrown upon the retina of the eye, but from there through the optic nerve the image must be carried to that particular portion of the brain which functions with the eye, and still further, through the psyche or mind must then be translated into meaning. And when it is remembered how long it took the child to learn the alphabet—how long it took then to learn to write it—actually to form words—and lastly to get a meaning out of these words and make them stand for actual sounds and thoughts, one may with little imagination realize how complex even simple acts are, and how extremely complex the higher mental processes must be.

Everything we are, think and do, is determined to a very large extent by what we are born with. This is what the Psychologist means by a "biological setting." In other words, if we did not have a good nervous system—for every act, no matter how simple or complex it may be, is performable only through the nervous system at large, and the co-ordinating organ, the brain, in particular—it would be impossible to learn anything well or do anything well, for practically every seeming simple act is complex and it is necessary for our central nervous system to co-ordinate all

the many nerve arcs that enter in the action to be performed.

Another way of putting the matter would be to say that all we are and can be is determined by our instincts and our habits, if we define instincts as being the sum total of every tendency of the nervous system to function with which we are born, and every habit, the acquirement of everything we do after birth, never forgetting that a habit can only be formed upon a tendency that is already present and capable of performing.

We are born with certain nerve-arcs ready to function in certain ways, which we have designated as "tendencies to act," and that these tendencies be all normal, we must have a normal nervous system, which means in turn that we must have a normal biological inheritance.

One of the findings of recent years is that different people do not react to the same stimulus in the same way; that each nervous system has a particular tendency to react in certain ways to certain stimuli, and this divergence, or variation of tendencies to react in certain ways, is the resultant of Mendelian unit characteristics; that is, that just in so far as a certain unit tendency was present in the dominant parent, will it appear, not blending, but singly and definitely, or be absent altogether.

The Psychologist is trying to build upon this biological background, by finding out definitely what tendencies are present in the child and developing these; or taking a rival tendency and developing it, so that this latter may become the stronger; for development or learning simply means the bringing about of a habit founded upon an instinct that is already there. It means that the strongest tendency will always be the one chosen and that true learning, using the word now as synonymous with education, means the choos-

ing, and by active usage, the developing of those mental and moral tendencies which we wish to foster, so that these will become the stronger and come naturally to the forefront at any given moment; to force these desired tendencies into active acting so often and so constantly that the whole physical makeup responds even subconsciously in the manner that we would have. As an example we may cite the instance of a child just beginning practice on the violin. The fingers on the left hand are pointed downward in readiness to press upon the particular string in the particular position required, but, very often the little finger points almost directly toward the zenith instead of downward. This is a natural tendency, for nature apparently did not have the violin in mind when our hands were fashioned. But notwithstanding instinct as here displayed, there is also a tendency to bend the finger, though in this case not so strong as is the tendency to lift it. Were there no tendency to bend, we could not acquire the ability of which we are speaking. So the teacher insists on bending the finger into the desired position and though the student often forgets and the finger will again assume an erect position, still, by constantly insisting and forcing the finger, we can bring about the condition in time that we wish, so that after years of practice, the older tendency which was really the stronger at first—the one lifting the finger skyward—has been entirely superseded by the downward position, and it is very difficult to make the finger follow out the original tendency without considerable effort. This is what the Germans call "einübung"—to drill into—and can only come by actual DOING and not reading about it. It is from this principle that our laboratories have sprung, so that students may themselves perform the experiments, the tests mentioned, and feel the convincing power of actual

DOING.

It has been well said, that an education is of no value unless it makes one *feel* differently in regard to the things one sees, hears, and does, from what one did before having such training. This means that any training must first, through direct conscious effort, become so part and parcel of the individual that it will in time become subconscious.

As an example of a training of this nature by actual doing, though not directly applicable to school and class work, an amusing occurrence came to light the other night in one of the dormitories of the University. One of the boys, formerly employed by an express company, sprang from his bed as the passing train whistled, grasped a chair and, using it as a truck, threw his neighbor's clothes thereon and pushed his supposed truck around the bed several times. Here the association of pushing a truck with the whistle of the incoming train, having been so often connected, started his muscles going through the entire process of the work to which he had been accustomed.

When we make our training not a matter of memory, but an association of this nature; when we are able to make the individual adapt himself to his surroundings, or shape his surroundings to himself, then we have performed our task of training thoroughly.

It may be said that all the foregoing is self-evident, and having been written in non-technical language it seems so. Yet we are prone to forget that the simplest and most self-evident things are just the ones that receive least attention as a rule.

We are entirely too much inclined to accept a *prominent* characteristic as the *significant* one. Just an example: take Dementia Precox, a type of insanity to which youth is prone. The child may be deeply interested in geography

and nothing but geography. He seems unable to become satiated with his subject. He has no other interests. The proud parents, not knowing otherwise, assume they have a veritable prodigy. Suddenly he changes to some other form of study or amusement just as whole-heartedly. He must be a genius, they think, if he can become so terribly engrossed in two different subjects, but—just the reverse is true. It is not astonishing that he knows so much about one subject as *it is astonishing that he cares so little for anything else.* In a short time the child knows practically nothing and stops growing mentally, remaining at the *mental age* of seven, nine, ten or whatever it may be, for the rest of his days.

It is to be remembered that we have already laid stress on the fact that an education is for the purpose of making one *feel* differently toward things. Here then is the crux of the entire subject. Our lives with few exceptions are made up of emotions, not reasons. We like or dislike an individual, and should he whom we dislike do anything of value, we assume he must have had some ulterior motive, while he whom we love must have been sorely tempted to do anything of which we disprove. We wish to demonstrate this by calling attention to the fact that the parent or teacher who loves the child most is the one least likely to be of service to him. We all know that the physician does not treat his own family in anything of a serious nature. He calls in one to whom the patient is only a "case." There must be no emotion in serious matters.

All of us have heard the statement "that if I hadn't seen this with my own eyes, I should not have believed it," when the speaker should have said, "I have seen this, but until some one who is trained in this matter has passed judgment I will not believe it." For one is very often deceived by

confusing *feelings* with *facts*. Often people say they *see* when in reality they do not, but only feel, or even only assume the object to be as it seems to be. This is well illustrated when we attend a picture show, where, though we gaze at the screen for an hour and a half, the picture is only *actually* before us about twenty per cent of that time, but we really *see* something all the rest of the time we are looking at the hero who has enraptured us. This seems more or less absurd and yet it is true, for there is a tiny shutter that keeps on closing the lens constantly and for much more time than it remains open. For it takes a certain length of time for an image to be seen after it is looked at, and also, after the object has been removed it takes some time before the image that was thrown upon the retina fades away. In other words, one never knows the precise moment when one begins to see anything, nor do we stop seeing it when we stop looking. All these things are easily demonstrable in the laboratory, but the point we are making is this, that it requires a training, if one wishes to be sure of his ground, even in the simplest matters, and this training is what we mean by *education*, which, together with environment and heredity, form the triangle that constitutes the basis of genetics in all its fullness.

Heredity, by some considered the greatest factor, is the fulfillment of Dr. Oliver Wendell Holmes' dictum that the proper time to begin right living is two hundred years before one is born, while environment and training, closely related as they are, if used in their broadest sense, fulfill the thought expressed by the proverb, "tell me with whom you go, and I'll tell you what you are."

Education is not a natural process, but an artificial one, based on natural tendencies. The natural way would be to follow one's instincts regardless of what they were. And

we must not forget that we have both *right and wrong instincts* and either can be made stronger than they are at birth. In some, the right ones are already strong while in others the reverse is true, and the important point to be emphasized is that we can, through inheritance, see to it that one or the other is already given the child at birth, so that the terrible effort of changing them will be materially lessened or entirely overcome.

The next point is that the emotions are not the same in every individual when the same thing is seen, heard or touched. We must not judge others by how *we* feel, or *think* we should feel under the same circumstances. It does not follow that because a full grown individual reads something evil into a picture play, that a child does likewise. And from this we may infer that it may not be correct to judge a child by *our standards*, but realize that he is in a process of development, and the judging standard is relative. "Does he do as well or better than the average of that particular age?" is the criterion, and not "Does he do as well as I?"

And lastly we must remember that it is in MEANINGS —in interpretations—that we find our difficulties. We can only interpret in terms of our own knowledge and experience, and so when we see men at a great distance, we know they are of average size just the same, but in reality we do not *see* men of average size, but very small men. The child has not had this experience, and so he says actually what is true, that he *sees* very tiny men, when viewed from a distance. We older people usually tell him he is wrong and insist upon his telling what he saw in terms of what *we know* to be there. The child is often thought untruthful by his elders, whereas it is they who are in error in their statement that they can see men of average size at a distance.

We have attempted to show some of the angles from which Genetics can be viewed. We have not attempted to answer any questions, but to state in as simple a language as possible what is now held in this field. Some say that the answers to the many questions that can be raised in this study lie with Biology; others believe that Psychology can do more, and yet others think that the Statistician holds the key, in that he gathers all the facts with their relative frequency and passes judgment upon them. Of the Psychologists there are various factions, represented primarily by the introspectionists on the one hand and the behaviorists on the other; the former believing that self-introspection may throw light on our mental processes, while the behaviorists believe that introspection is worthless, and that the child must be studied as objectively as the animal of lower type would be. That is, consciousness must be left out of the question altogether, and a definite problem, fitted to the child's organism, must be presented, and then an exact record of the reaction resulting taken, and when every possible act has been studied in this manner we shall have a quantity of statistical matter from which we may be able to draw up a theory that will give us what we seek.

As the matter now stands, the word "soul" no longer appears in the psychological literature; "mind" was substituted for it some years back, but that, too, has been relegated to the refuse heap of obsolete terms, to be replaced by "psycho-physical reaction," words of "learned length and thundering sound" that mean little.

The definition of Psychology itself has changed from the "science of the soul" to that of the "science of consciousness" and when it was later discovered that maybe there was really more in the subconscious than in consciousness itself, we have it defined as the "study of mental

phenomena," where it now stands.

Man, too, was supposed to have arisen in several ways, one being from a hairy ape, from whom by a step-brother removed, he parted company. But since Professor Hugo de Vries, the great Dutch naturalist, brought forth his theory of "sports in nature," and that these are often of the dominant type and breed true, it has led the modern psychologist and behaviorist, Professor John Watson, at least to say that no one any longer looks for a missing link,[2] for we know that somewhere in the scale of evolution, Man, by an immeasurable distance, separated himself from the rest of the animal world.

Can we not see in this but another way of coming back to our older and supposedly disproven doctrines?

But "stay," says the Alchemist to his weeping wife, in Balzac's powerful novel, "stay, I have decomposed tears. Tears contain a little phosphate of lime, some chloride of soda, some mucus and some water."

Is that all that constitutes a tear? Is a mere reaction to a stimulus, what we mean by life?

[2] Behavior, An Introduction to Comparative Psychology, by John B. Watson.

CHAPTER IV

METAPHYSICS AND EPISTEMOLOGY

THERE are three factors with which we constantly have to deal in finding our starting point in any science: (1) The "Fact" or observation itself; (2) The ability of the scientist who announces an observation, or states a theory, and (3) The honesty of such person in giving his views to the world, for, it is perfectly conceivable that one who knows more than any other man on a given subject may still not be honest in his pronouncements, due to a desire to bolster up some favorite theory, or to a so-decided idea of his own correctness at all times, that but a single side of what the observations may mean can be grasped.

In our chapter on "Authorities," we shall examine into the method of ascertaining who is and who is not capable of passing judgment in the fields of science that we are here discussing. In this chapter we wish to show why it is that we lay so much stress on the two branches of philosophy, Metaphysics and Epistemology, which are absolutely essential to any thorough understanding of any science.

Taking the first mentioned philosophical branch, we quote the following from Professor William James' *Briefer Course* in Psychology published in 1913, page 460.

What the word Metaphysic means. In the last chapter we handed the question of free-will over to "metaphysics." It would indeed have been hasty to settle the question absolutely, inside the limits of psychology. Let psychology frankly admit that *for her scientific purposes* determinism

may be *claimed*, and no one can find fault. If, then, it turn out later that the claim has only a relative purpose, and may be crossed by counter-claims, the readjustment can be made. Now ethics makes such a counter-claim; and the present writer, for one, has no hesitation in regarding her claim as the stronger, and in assuming that our wills are "free." For him, then, the deterministic assumption of psychology is merely provisional and methodological. This is no place to argue the ethical point; and I only mention the conflict to show that all these special sciences, marked off for convenience from the remaining body of truth, must hold their assumptions and results subject to revision in the light of each others needs. The forum where they hold discussions is called metaphysics. Metaphysics means only an unusually obstinate attempt to think clearly and consistently. The special sciences all deal with data that are full of obscurity and contradiction: but from the point of view of their limited purposes these defects may be overlooked. Hence, the disparaging use of the same metaphysics which is so common. To a man with a limited purpose, any discussion that is over-subtle for that purpose is branded as "Metaphysical." A geologist's purposes fall short of understanding Time itself. A mechanist need not know how action and reaction are possible at all. A psychologist has enough to do without asking how both he and the mind which he studies are able to have cognizance of the same outer world. But it is obvious that problems irrelevant from one standpoint may be essential from another. And as soon as one's purpose is the attainment of the maximum of possible insight into the world as a whole, the metaphysical puzzles become the most urgent ones of all. Psychology contributes to general philosophy her full share of these.

It has been deemed best to quote this entire paragraph, as Professor James is without doubt one of the most quoted of men and one deemed by his compeers as being as worthy of being quoted in his field as any other American writer.

What he says is simply another way of saying that if a man does not want to become a "specialist" in the sense that the late Elbert Hubbard defined, as being "A man who only knew enough to know one thing," it is more than necessary to go a little beyond the physical world, which is all that Metaphysics means (meta meaning beyond, or after physics, that is, it is the discussion that follows the physical sciences and gives the grounds on which they rest, and without which they could not be possible), i. e., going further back—deeper down than the merely sensible (those things that come under the senses) and finding a starting point that is more than a mere supposition. In other words, he should, if he really deserves the title of a thoroughly educated man and scientist, know that, while it is interesting for the painter to examine very closely the grain of the wood going into a building and for the mason to examine the stone-work, still we have the entire building to consider, and only in so far as these details of stone-work and lumber and grain contribute toward the fullness and beauty and value of the entire structure is it worth anything in the final analysis. And so any science is but a special branch of life, and its work, no matter how interesting in and of itself, *must be looked at from the world-viewpoint to find its exact place and fitting value.* Each one of the sciences is sorely needed, and every detail of that science may result in any quantity of value, but it must be balanced with all the other sciences, *and this balancing is always the work of philosophy and not that of the laboratory man.* For philosophy means to find ultimate causes. Whenever a man *thinks,* he philosophizes, and whenever he observes, that is, whenever he only sees a thing and finds that he can always see the same thing under the same circumstances he is what is at least *popularly known as a scientist.* The moment he

puts his observations together and tells what they mean, he enters the field of philosophy.

We do not accept the definition that we are here stating, for we contend and hold that *the only true science is philosophy*, and it is no very difficult matter to look at any encyclopedia or other work of similar nature and note that *every man* who stands at all well in any scientific specialty, obtained that standing by his philosophizing and not by his science, using the term "science" in the sense which men at large use it, that is as a worker with laboratory objects that come under the senses. We wish likewise to show that every objective discovery that *means* anything, has to be *thought about*, for meanings can only be given through thought-processes, and thought-processes by no means come under the senses.

Further, every fact, whether physical or otherwise, must rest in the final analysis on what we call "First Principles," and "First Principles" are what we find as self-evident; they cannot be proved. These principles *must be accepted and are*, by every educated man in every walk of life, for without them the entire world of intellect and thought would be hopeless chaos and could not exist at all. These principles, we say, illumine the intellect, that is, without their acceptance there could not be anything at all that would mean anything to the human mind. There could be no science, no connected speech, no thought, no telling another what one meant or felt or thought. It is the light that makes all that we have possible and understandable. But to say that First Principles can be experimented on in the laboratory is absurd. First Principles are not sensible things and what is not sensible cannot come under the senses, and what cannot come under the senses surely cannot be tested in the laboratory, for all

that physical science means is the testing of, and finding laws in the world of things that *do come under the senses*, so that even in Psychology as used by Professor James in the passage quoted, he has separated that science into two parts without any connecting link. He is speaking of Physiological Psychology only, that is, the effects of the physical states of the body on the mind and vice versa; not the study of the mind in itself, this latter is called Rational Psychology.

To show what a few of these necessarily accepted Principles are, we may mention the necessity of assuming that *what we see, actually corresponds to what is* actually before us: i. e., *that the senses do not lie.* We must accept that when we hear anything, there is a sound that we hear and that it must be akin to what we actually do hear; we must accept that we are capable of thinking, and that speech is capable of telling our thoughts to another, and that those to whom we tell them are constituted as is the speaker, so that the telling means the same to one as to the other.

The very fact that we think, shows a thinking individual and a thing thought about. This brings about the idea of relationship, for, if we are conscious of thinking and of something thought about, we immediately understand that here are two totally separate things, which bear more or less relationship to each other. And there are many things in every-day science that we accept only *on a showing of this relationship*, without ever being able to find, or bring under any of the senses the things themselves of which we are absolutely positive. For example, this is true of atoms and molecules and electrons, which no one has ever seen and yet all accept. It is true of gases, which can be known only through their relationships, for our senses can-

not distinguish them, except through such relationship; and so also, electricity is known only by its effects, which is another way of saying, by its relationships.

Now, if we accept Rene Descartes' philosophy, and it is this philosophy which most men of science seem to hold, we must begin as he began, with the statement, "I think, therefore, I am." But here again we find what we have just been insisting must be done, namely, to accept something as a foundation that cannot be proven, and this little statement of Descartes is his First Principle. It is on this First Principle that he and his followers build their theory of knowledge (a theory of knowledge is all that Epistemology means) which may be summed up like this: that if one has a clear and distinct perception of a thing, then it must be true. De Lamennais in his "Defense" of an essay he had written, gives an amusing account of a supposed dialogue between a lunatic and a Cartesian (as the followers of Descartes came to be called). The lunatic claimed to be Descartes himself, and the Cartesian insisted that this was impossible because Descartes had then been dead some hundred and fifty or two hundred years, to which the lunatic responded, by asking how the Cartesian knew that he himself existed. Receiving the answer, of course, that he "thought" and therefore knew that "he existed," as well as having a "clear and distinct perception" of that fact, the lunatic called to the Cartesian's attention that he (the lunatic) also "knew" himself to be Descartes himself, because, he, too, "thought and had a clear and distinct" idea that he was what he claimed to be. The Cartesian walked away slowly murmuring, "I was right, the poor fellow is mad—what a pity! Still he is none the worse Cartesian for that."

To the philosopher then the statement that a man ac-

cepts nothing but *facts that can be proven in the laboratory,* this whole procedure savors hugely of a joke, and yet daily we hear these same empty remarks passed about.

There is no doubt that two friends, unable to agree on politics, may yet discuss all other subjects with perfect equanimity, and that, knowing their shortcomings in the realm of political discussion, agree among themselves not to mention the forbidden subject. This is exactly the situation with laboratory men. They cannot agree on anything whose evidence does not come from and through the laboratory, so they have simply agreed not to discuss anything outside of the evidence so obtained. This does not imply that there is nothing beyond the laboratory, or that that which is beyond is not of more value than is that which comes from the laboratory, any more than the case cited of the friends and their non-discussion of politics argues for their being no such thing as politics or that that subject may not be of vastly more importance than the trifles they may discuss constantly. *It is simply an agreement, and has nothing whatever to do with rightness or wrongness, or with better or worse,* and it is only those who, through ignorance, or a desire to make capital out of the ignorance of others, use this as an argument that scientists are opposed to the things they do not discuss, such as religion, for example. One can easily see that to come to such a conclusion, the *facts* are neither known nor used.

It is no wonder, then, that many have come to a similar conclusion, i. e., that Metaphysics is worthless because it is not discussed in the laboratory, and have assumed that there must therefore be something in laboratory evidence which has disproven it, that there is nothing beyond what the sensible evidence can present—but we think Pro-

fessor James' paragraph makes this viewpoint untenable.

Further, we must not forget that *Faith means only the acceptance of evidence on the authority of another*, and without Faith, no science would be possible, for no single individual can possibly work out the details of every problem that confronts humanity. One must take a thousand things on Faith and Faith alone, for every detail of life for which one finds the evidence for oneself; and if we carry this idea, here slightly developed, to its logical conclusion, we should have to say that in as much as many people accept such statements as we have just condemned on pure faith, and if superstition means anything it means just that—accepting a lot of untruths, simply because one wishes to believe—surely these people who say they accept nothing on faith are the most hopelessly superstitious of any people known, in that they do not even have the justification of the men in ages past, who believed that an all-powerful God could and did perform miracles, whereas these latter assume that the magic wand of "so-called science" can do the very things they condemned simple people for believing an Infinite Agency could perform.

Note that we say "so-called science," for it is not science that tells us any such foolish things, but those men who, having a smattering of scientific terms, and a superficial knowledge of one branch of that immense subject, or who, having some pet doctrine to bolster up, constantly write and publish their writings, until the poor layman, unable to pass judgment, and seeing the vast flood of literature on the subject staring him in the face from every newspaper and magazine, concludes that because this man knows how to advertise himself and keep himself before the public, therefore he must be a very great man in his field, and consequently accepts his doctrines as the truth. Most

often, however, the man of science is hardly known outside the immediate circle of workers in his chosen realm.

This is well exemplified in the naming of America. All of us are familiar from our school histories that there was a man called Americus Vespucius, who wrote on the subject of our land, then newly discovered, and that another man, also a writer, not knowing of Columbus, and only having read the works of Americus, assumed that *he* must be the truly great man, and therefore in his volume, the name of America was given to the New World. If our very land was christened in this erroneous manner, we ought to have a good example constantly before us, of *how not to get our scientific dicta.*

Most people forget that it was not so many centuries ago (five or six) that all the English speaking people in the world were not many more than the inhabitants of Chicago number at present. They forget that in the fourteenth century a great reign of disease called "the black plague" overran the land and killed over half of these, and that from these few people, inhabiting a very small island away from the continent of Europe, isolated from the great world at large, we draw most of our ideas of history, of religion, of law and of science.

That is, this land of England, had a more circumscribed view of the world at large than other lands had, yet, because we in this land of ours speak English, we feel, through the bonds of Language, the false idea that whatever is written in our own tongue must be best. We forget, for example, that immediately after Henry VIII's time it was only possible to write things praiseworthy regarding the state church, because this was the acknowledged religion, and that for over three hundred years, Englishmen could discuss anything and everything but religion in a historic

spirit.

It requires no great intellect to understand that if through three hundred years the generations of children born and bred in England were forced to listen to fulsome praise of their own sect, and never a good word regarding an institution that gave them the very civilization and strength by which they upheld that civilization, that these children would form an intense hatred for a Church thus condemned, and that for no other reason than because they accepted on faith that which was in turn taught them. Bear in mind these people were not dishonest. *They were the result of dishonesty,* but the point to be insisted on here is that in matters of history (because the Church was the maker of history during the Middle Ages), any one not being able to read any language other than English—any one in England, during these three hundred years, unless he was able to smuggle in volumes from other lands, could not get a correct account of history or religion for many, many centuries, and this is why we, who speak English, are at a greater disadvantage, unless we go to other nations, than possibly any other race under heaven, to get at a just valuation of the past.

This is mentioned in the interest of philosophy and not of religion, for we cannot get a broad world-view unless we have a proper perspective, and that we can get only if we realize that to us, who speak English, has been lost for three hundred years an intellectual ancestor with whom we must again become acquainted, and that from reliable sources.

The average laboratory worker as well as the average college student assumes that if he start on the subject of Metaphysics or any other branch of philosophy, he will get nothing tangible—nothing that he can grasp. He assumes it will all be vague and not like the experiments he has been ac-

customed to perform, and because he has seen the many conclusions that can be drawn from the same premises, the very bewilderment of it all, the immensity of the subject, the vast quantities of literature on philosophy, all frighten him into the easier path, of total neglect. And some who wish to go on, fear for themselves, knowing, for example, that the Scholastics used their philosophy to prove the validity of the Catholic position, and not wanting to have anything to do with Catholicity, they will not even investigate the *only* system of philosophy that has held millions in sway for over seven hundred years and which to-day is coming back into its own, as witness, Professor De Wulf of Louvain, now at Harvard; and Johns Hopkins University offering a Professorship in Scholastic Philosophy to the Jesuits, which latter, however, was declined.[1] Witness also the statement of Professor William James, written shortly before his death, that *he would have to accept the Scholastic viewpoint or throw all logic to the winds.*[2]

It is, of course, permissible to start anywhere, provided all parties to the discussion are agreed. It is perfectly legitimate for the Mormon elder to start with "you all agree that Joseph Smith was the chosen leader of God," provided all his hearers already accept that view, but it would likewise be very unreasonable to begin in that way

[1]The Catholic Educational Association Bulletin, Vol. IX, No. 2, February, 1913. Page 21.

[2]"I saw that I must either forswear that 'psychology without a soul' to which my whole psychological and Kantian education had committed me,—I must in short bring back distinct spiritual agents to know the mental states, now singly, now in combination, in a word bring back scholasticism and common-sense—or else I must squarely confess the solution of the problem impossible, and then either give up my intellectualist logic, the logic of identity, and adopt some higher (or lower) form of rationality, or finally, face the fact that life is logically irrational. . . . Those of us who are scholastic-minded, will smile at the elaborate groans of my parturient mountain resulting in nothing but this mouse." Page 208, of the "Pluralistic Universe," by Wm. James.

to a crowd of people who ridiculed Joseph Smith and considered him an impostor. So there is no fault to be found when men agree to limit the work under discussion, but *where fault is to be found*, and that most strenuously, is where, because after a few generations of such training, the new student is taught to accept the doctrine *that because men of the physical sciences start at a given point, there can be nothing beyond that point.* Men who permit students to accept this viewpoint are neither scientists nor philosophers and would deserve scant treatment were it not for the fact that some of them occupy high places, and by virtue of their positions, can, and do, mislead many, for it seems to be a characteristic of human nature, to follow men who know much in one line, assuming that because of this they must know much in every line.

Enough, then, has been said to show that the very basis of science rests on a necessary assumption, pure and simple. In other words, *we start somewhere*, and that *on unproved truths* in every science and in every piece of work that mankind does. In both philosophy and in science we begin with what are called First Principles, or self-evident truths. It is of the utmost importance that this be clearly understood—that every science and every philosophy *must begin with some accepted Principles*, that is, with certain definite truths *that cannot be physically proved.* Every suggestion that a materialist makes, every "fact" he mentions, can be proved only on the basis of these First Principles, which are not "facts" at all in accordance with his definition. They are only the starting point, and as they cannot be proved, he must admit that in the final analysis he must depend on totally unproved points to give any validity to his further philosophizing.

Now, if every starting point must be a series of accepted

truths—that is, First Principles—we can and must have a branch of study, call it philosophy or science, whatever you will, that aims to formulate a "theory of knowledge," i. e., a study, that gives us a *validity for our reasoning*, that tells us *what we can know*, and *how we can know it, and weighs the continuity and universality of the First Principles thus found.* This is called Epistemology, and means only that we try to sift to the ultimate all that we can know; for surely, if we admit that we can know anything, we ought to be able to tell *what* we can know, and just *how we can be sure that we know it.* It aims to give us *criteria.* In other words, Epistemology attempts to answer the question, "What can I know, and how can I be sure that my answers are correct after I get them?"

One often *feels* one knows a thing, but from a scientific standpoint this is worthless; one must *know*, and be able to give an intelligent reason for that knowledge, and that can be given only on the proof of First Principles.

Truth is *absolute* in the Scholastic Philosophy. It is not in the Pragmatic, but the meanings of the same word are changed in the two schools. Because some "so-called truths" are not absolute, it does not follow that no truth is absolute. But surely it is much wiser to continue the older method of defining truth as "the correspondence between the idea one has of a thing, and the thing itself." This does not mean that it is necessary to see life from two sides only—that things must be on one side or the other—that is, that there are only two alternatives. Life is entirely too complex for any such viewpoint, and any mind that only sees two points of view is entirely incapable of passing judgment on any subject that requires a wide range of vision.

Professor James says that "Metaphysics means only an

unusually obstinate attempt to think clearly and consistently." The Scholastic would say that as Metaphysics means the study of that on which all physical science depends, it obstinately *forces* one to think correctly and consistently.

It is the almost hopeless confusion caused by not thinking clearly and consistently, as well as the lack of a standard use of words, that give rise to most of our difficulties in the realm of thought. An excellent example and one bearing directly on the subject so frequently met with is the varying meanings given by different writers to the word "law." By some it means a custom of the people crystallized into a written code, the breaking of which is the occasion of punishment of the offender. The law itself having been formulated by a law-giver, whether a single individual, such as Moses or Lycurgus, or by a body of legislators. Then there is the other law which we are constantly using in the realm of science, and which, because it is the same word, is so constantly confused, and the meaning of the word, as explained above, given to it, when it is as different as day is from night, for a "law" in the physical universe means only that, in so far as we know, *a particular following of one thing after a similar antecedent under the same conditions, has no exceptions.* This kind of a "law" has absolutely nothing whatever to do with the kind of a law mentioned first. The first "law" is a moral affair, telling what is right and wrong in the moral order; the second hasn't a thing in the world to do with right and wrong—it is totally disconnected with any moral bearing of any kind. It is merely *an order of happenings to which we as yet know no exceptions.* It means the arrangement of a succession of events or phenomena, and is found by observation; and, it may be that at some future time an exception

may be discovered, and then it will cease to be a "law." Though of course a law in either sense used above implies a reason for that law or, as often said, any law demands a law-giver. This was even admitted by Professor Plate, a very decided Monist, in the famous biological discussion which took place in Berlin in 1907.[8]

Now all science is based not only on First Principles (remember not on physical facts), but also on the further supposition that every regular succession of events from antecedents similarly conditioned implies a law, and always follows in the same path, under the same conditions that it does now. In fact, there could be no laboratory evidence at all—no physical science—if we thought that the same event or phenomena would not always take place in the same way under exactly the same conditions; in other words, if we thought that different effects could come from exactly the same causes under the same conditions.

It must be admitted, even without proof, that every effect needs a cause, and there could be no science at all without this belief. It must be further assumed that the same causes have always led to the same effects, do now and will so continue; always, of course, the same conditions being likewise assumed. That is, we have observed during historic time that the same effects have always flown from the same causes under the same conditions, and on this continuity and perpetual law, we have formulated other laws. But every scientist admits that things were not always as they now are. Life was not always upon the earth. If we suppose the earth to have once been a very hot mass of matter, so hot that it was molten, we know that even if there had been living matter then it was killed, for no germ, even of the most persevering type, has been able to stand much more

[8] The Problem of Evolution, by Erich Wasmann, S. J. (Herder).

than a temperature of 165 degrees Centigrade, so surely, when the heat ran into thousands of degrees, life was not there. It does no good to suggest that meteors and other falling bodies, or dust from other planets may have brought life to this globe of ours, for these other planets were once molten also, so it is only pushing the problem back farther but not giving any answer. IT MUST HAVE STARTED SOME WHERE AT SOME TIME. But we know from all our evidence that Life comes only from Life. No one has yet been able to show that life can come from non-living matter, and yet we are confronted with the fact that as we have life now but did not have, at some remote age of the past, life must have come from non-living matter, or a creation must have taken place. But the point here made is that we have a break in the very *law*, at the outset, on which all our science is based. For we must never forget that without continuity of laws, there are really no laws, and if there are no laws we have no science. We want to impress most firmly these very first things necessary to a proper understanding of science and its limits.

Again calling attention to Professor James' paragraph, and to what we have said above, in all physical science we must start at some point on which all are agreed, *regardless of whether there is more evidence for some other point or not.* For, as Professor James says, he accepts determinism for his science, *though believing that his opponents are more correct in not accepting it.* But there are two distinct sciences here involved, one Ethics, the other Physiological Psychology, and for Physiological Psychology we can, by accepting determinism as merely relative, and capable of being dropped at any time, deem it of considerable value in working out our problems of Psychology on a purely physical basis. Yet in Ethics, we must accept the opposite

doctrine or we soon cease to have any Ethics, for this science is in turn a branch of Rational Psychology.

To the lay mind this may seem like a hopeless muddle, and it is just this that puts the philosopher in a world by himself and makes him so thoroughly misunderstood by those who are unfamiliar with the mass of detail that he tries to weave into a meaningful whole. He is often ridiculed for his nice distinctions, and yet, through all this ridicule, the man who KNOWS, has through all the ages been respected and also feared and, as shown by our quotation in an early chapter, from President Hibben, his ideas have at last become the "maxims of the crowd." He has been ridiculed; for the man with lesser intellect, *being unable to grasp great depths, or unwilling to put forth the years of effort required to understand a subject fully, wishes always to justify himself, and thinks the easiest way is that of condemning and ridiculing what he can not understand;* but always in an emergency he calls on the man who knows. It has ever been so, and the leading weapon of objectors has always been ridicule, for they work on the principle of the elder attorney giving the young one the advice, that when the law was on his side, to quote the law; when the facts were on his side, to quote the facts and forget the law; but, when neither facts nor law were on his side, to ridicule his opponent.

When, then, there is an incapacity for understanding, ridicule is resorted to, and it calms the qualms of him who resorts to it, by making him feel he has the best of the argument.

Summing up, we may say, we start all scientific work on First Principles, which means only an assumption of things that are self-evident. Then we agree to start on some theory and work it out, contrary to the usual belief that

the evidence is first sifted and then the theory propounded.

So, having our First Principles and our Theory, we are ready to experiment, or to observe. Then we check up, and find, *metaphysically*, whether our First Principles are acceptable or not; whether there is or was any possible chance for wrong observation; whether, under the same circumstances the experiment varies; whether a thousand and one things were just as they should have been, including our instruments, the atmosphere, the eye-sight of the worker, etc., and whether the observer's theory has blinded him to anything but favorable results; for, knowing the answer he seeks, he all too often like the schoolboy, who, knowing in advance what the answer to his problem may be, obtains the results expected but by a most marvelous complexity of invalid work.

Then, and then only, after finding that other observers' findings agree with his own, has he the material with which to work. But now he must produce his links in the chain that he is forging. Only the crude iron has so far been found, now it needs hammering, and changing, to be welded into links, and these separate links, in turn, must be joined together to make the perfect chain. *The bare facts are only the metal; the separate sciences (called also the special sciences) are the links, and the chain is the logical whole, welded together with a proper regard for every separate link, with a pounding here and a pressure there, discarding, waiting for further material to make a link still stronger and greater so it may truly fit with the remaining ones, sometimes missing a link, but trying to make each as symmetric as possible, so that the whole chain forms that true mark of workmanship that every man hopes for, when he works to obtain perfection, and this is all the work of that other great branch of Philosophy called* LOGIC.

CHAPTER V

LOGIC

MR. BALFOUR, in his volume on philosophy, published in 1896, makes the very definite statement that "A sound epistemology is at the basis of all science.[1] This we have tried to show in our immediately preceding chapter, but as this is not a text-book of the special sciences, nor of philosophy, but a statement of their value, we shall not enter into any more detailed study of this particular branch, but furnish a list of volumes at the end of our work, so that he who wishes may delve as deeply as he likes in any of the special sciences mentioned. He will thus learn that there are men equally intelligent, who hold decidedly contrary doctrines on nearly every subject, though usually these doctrines are formulated from the same facts. This chapter will therefore take up the *method* of formulating theories and doctrines.

We wish to quote another line from Mr. Balfour's work. "The argument from 'an authority' or 'authorities' is almost always useless as *a foundation* for a system of belief." And commenting on this, Professor St. George Mivart says, "More than this: it is and must always be not only useless but absurd. Every system of belief must repose (1) upon self-evident principles; (2) upon our conception of the fact of our continuous existence, and (3) on the evident validity of our logical reasoning." [2]

[1] The Foundations of Belief, by Arthur Balfour.

[2] "Balfour's Philosophy," by St. George Mivart, American Catholic Quarterly Review, January, 1896.

This bears out what we have been insisting upon in our previous chapters, namely, that all science starts with self-evident principles; that to go on from here we must accept the doctrine that all data and theories would be worthless were we not positive that every effect must and always does follow the same cause under the same circumstances and conditions—in other words, we must accept the doctrine of continuity, and lastly, we must accept the third part of the triad, that all theories, all proofs, all arguments must be logical, and it is to this subject we shall devote this chapter.

For the mere facts gathered, whether in the schools or from the experiences of life are but the crude material from which to construct our chain. The separate sciences are the individual links, and now, having these, we must try to stand on an elevation where we can see the result of all the special sciences woven together—we must try to be philosophers, and, as such, weld our chain from the separate links at our disposal. *That is the object of Logic*, and it must be understood before any one in any science can make his work *mean* anything. For surely it will be conceded that if one has spent the years in merely accumulating brick, it is a reasonable question to ask what is going to be done with the gathered material; and just so reasonable is it to ask of an observer, after his note-books are filled with the facts he has accumulated, what *he* is going to do with them all.

We may readily admit that the things he has seen are interesting, just as the wonderful Chinese figures and writings are interesting, but what do they mean? And this is where all the wranglings come in. *We all agree on the "facts"; we do not agree on what these same facts mean.*

No man can be even reasonably sure, intellectually, of any

opinion he passes on any subject unless he knows something about Logic. *He may be able to reason correctly and may do so, but he has no rules by which he may* KNOW *that he is reasoning correctly,* without such knowledge. So that, in lines of work with which he is pre-eminently familiar, his opinions may be worth a great deal, though he cannot tell *why* he thinks as he does, but the moment some one tells him something of some other line of work, or he reads an article on a subject of which he knows little, it is an easy matter to state fact and fancy side by side, and he will not know "which is which." This is Logic's great value, for, even in the daily walks of life, it enables one, though the opinion be passed in totally unfamiliar fields, to stop the speaker, and ask what the "facts"—the observed facts really are—and what proof there may be for them. Then to be able to point one's finger at the weak place in the argument and say, "But here is where the facts end; now you are philosophizing, and I want to follow step by step. I do not want *your assumptions* or *opinions, I want to know* HOW YOU GET THAT OPINION—*by what process—and that every successive step taken to build it is valid!*" Logic is used daily in the market-place, in the forum, in the physician's office; without it no reasoning could be done; no business transacted; no thought uttered that would mean anything; and it is due to the ignorance of the laws of Logic that so many people are misled by untruths; by erroneous reasoning, into paths from which they fain would extricate themselves.

It does not follow from this that each and every one *knows* Logic. Few do. *But men use it,* just as the child speaks its mother tongue long before it learns its grammar, and Logic is the grammar of thought. As grammar is the method of permitting the child to check himself up

and find whether or not he is correct in the usage of his language, so also, while the child may speak a perfect English because he is always with those who do speak correctly, and while some may reason correctly because they are constantly associated with those who use good reasoning methods, still, even then such a one could not be considered at all educated, for, to be able to do a thing without being able to explain why and how one does it, does not speak for intellectuality; and so any one wishing to be able to do his thinking well and correctly, *must*, if he care at all to know that he is correct, study his Logic.

The reason for this will be made the more evident when the ending of the preceding chapter and the beginning of the present one are remembered. For to weld our chain we must build up our matter step by step, until we have made it into a complete whole.

That is, every scientific theory, every scientific law, every thing that amounts to anything, whether good or bad, in science, philosophy, religion, business, law, medicine or any other walk of life—every thought that is formed on another thought, every series of ideas, every opinion on any subject, and every judgment passed, *must be logical to be worth anything.*

We must start with a premise. We start with something on which both sides are agreed. *This premise may or may not be correct in itself*, but one can get nowhere without this starting-point. Logic does not assure us that our premise—our starting point—is correct. *That* lies with First Principles and with Epistemology—with Certitude. *Logic only shows us how to reason correctly after we have established what we are going to reason about.*

This is all in the "abstract," as contradistinguished from the "concrete." In other words, we have nothing tangible,

nothing that comes under the senses. It is all a matter of mental processes, and therefore these studies are very difficult to the majority of men and women, who can think only in terms of the sense-world. But as we have just shown, that while *we must use the sensible things on which to build, yet our superstructure must come from the mental part of ourselves.* One must either admit this or cease thinking. There is no alternative, and there is no dispute among the learned on this point. No one insists that thought itself is material, though some have thought it was a direct emanation from the material, one ardent materialist even going so far as to think it a secretion, such as the gastric juice from the stomach or the bile from the liver, but gastric juice and bile are both material substances while thought is not.

It is just because *it requires sustained mental effort* that so few enter philosophical fields, yet we shall show that every man considered a scientist and acknowledged as such by his fellow workers, *is acknowledged as such on account of his reasoning—that is, on account of his Logic, which again is philosophy—that there has never been a man in any walk of life who has won any regard from his fellow-men, which did not come from his philosophy—from his manner of thinking.* There is no case on record, so far as the author has been able to find, where any scientific work has ever been done by man that was not the result of *thought* somewhere expressed, *and all thought is under the dominion of philosophy.*

This is so true that Professor Huxley, considered by any number of men as one of the great men of science, has gone on record as saying that he regrets that the term "applied science" was ever invented. That the men who invent, who *do* things, are not scientists at all, but simply workmen putting scientific ideas into practice. Yet the average man, were he asked who the greatest scientists were,

would, in all probability, point to such men as Thomas Edison and Luther Burbank, as well as others who by their genius and patience have brought a few more material comforts to mankind. But no scientist would even suggest that these men be called scientists. The true scientist is, what the man of the street would think of as a philosopher *—he is one who finds underlying "laws"—natural laws—and formulates methods* so that others who come after him may profit thereby. Edison, Burbank and others working in "*applied science*" could not have done the things they did, without the work of many men who have gone before, and *so it is the one who out of his own inner consciousness can put together the ideas, the mental abstractions into a meaningful whole who is the real scientist.*

Let it be asked at any of our universities who the great scientists of the past century were, and Darwin, Wallace, Huxley, Tyndall will come to mind. Mendel will take his place first in the list now, as shown by our chapter on "Authorities," but he wrote then only for a local audience and it was not until the year 1900 that his great work was discovered, which has been mentioned in the chapter on "Genetics," and whose theory is now one of the predominating ones in the scientific world.

Yet all of these men, though they did much observing, would not have been known except as other men are known, *were it not for the theories which they advanced and fought for.* It was an idea again, and not a "fact," for which they fought. It was a "theory," built up logically from their premises. Many there are who do not accept these premises, but Darwinism remained in force for almost two generations or until the philosophers showed the errors in its logic as well as the groundlessness of the premise with which the theory started.

This part of our subject will be discussed in our chapter on "The Present Status of Evolutionary Philosophy," as well as in the chapter on "Evolutionary Theories," but we wish here to point out that every one of these men conceded to be a great scientist by those who know, was a philosopher, and *it was through his philosophy* and *not through his observations that he is so acknowledged.*

Much of the looseness of discussion on this whole matter is again merely a matter of definitions of words. Men of the street and even of the schools, who have achieved popularity, tell us that science has explained everything, that science can do nearly anything. But the men acknowledged as *the great scientists* condemn all such statements and insist that those who make them are not scientists at all but mere workmen using the materials some one else has formed, and then not even using these materials justly. There is then a looseness in the reasoning process, for surely, if the men who themselves are greatest in this field do not acknowledge these men whom most people consider scientists, it is something of an anomaly for those who are not scientists to consider them such.

Were one to ask most men what science has done, they would unhesitatingly say it made the telephone, the telegraph, the ocean liners, the railroads, and a host of other things, from rocking chairs to chewing gum, but ask the scientist himself what the outstanding achievements of the last century are. Let us see what Professor Huxley says: "There are three great products of our time. One of these is that doctrine concerning the constitution of matter which, for want of a better name, I will call 'molecular'; the second is the doctrine of the conservation of energy; the third is the doctrine of evolution."

The average man is here inclined to throw up his hands

in despair, unable to get anything out of it all. Well, the average man will never get anything out of it. Only a man who studies will, and can, and ought, to get anything out of it, and the average man does not study. He is interested in "popular science" as it is found in the Sunday newspapers, with their glowing headlines of "Science tells why a baby sucks its toes," "Science tells why men play baseball," and other equally enlightening accounts, but surely not science in any sense of the word. Some man *who calls himself a scientist* tells us something which may, or may not, be true, *but that doesn't make it science.* It may be interesting, as it no doubt is, but if any one accepts such matter as science, it shows very conclusively that that man has sore need of Logic.

And it is just because the average man has never been able to make much out of science that the popular writer appeals to him. Unable, or unwilling, to spend years in the study of scientific subjects; unwilling or unable to think in terms that are not tangible; unable or unwilling to follow a consecutive argument through its logical entanglements, and unable to hold anything in his mind that isn't sensible for long periods, and think back on his own thoughts, he cannot get anything out of science, except to feel that somewhere, vaguely, and in some way, it is accomplishing something. And so he is willing to contribute toward the support of its professors, whom he cannot understand, yet, because he hears it said that Science is doing such wonderful things, he assumes that it must be producing something of value. To tell a man anything in his own department that is manifestly untrue will immediately get him to distrust you, but in a subject where everything and anything is called Science, and of which the average man knows so very little, it is by no means difficult

to "pull the wool over his eyes." Of this we have an excellent example in one of the most flagrant cases in recent years, by a man whom thousands of people swear by, and one whom they consider a scientist above all others.[8] That

[8]This reference is to Professor Ernst Haeckel of the University of Jena, whose falsification of various illustrations to establish his own theories, was shown by Professor Wilhelm His, in 1874. "In a book entitled *Unserer Körperform und das physiologische Problem ihrer Enstehung,* His shows how Haeckel in the first edition of *natürliche Schöpfungsgeschichte,* wishing to show the likeness of embryos of different species, gives on page 242 figures of the egg, one hundred times magnified, of man, the ape and dog; and on page 248 also three figures of the embryo of the dog, of the chick and of the turtle. He points out quite amusingly certain features of the resemblance in the three figures of these two series. Not only are these figures identical in outline but in nonessentials also. Thus it happens that the granules in a certain part of the dog's egg are coarser than in the other parts, and there is absolutely identical arrangement in the eggs of the man and of the ape. Very remarkably the first vertebra in the embryos of the dog, chick and turtle is a little more rounded on the right side, and the ninth a trifle narrower than the others. In short to make the pretended similarity as striking as possible, Haeckel used in two instances the same figure and gave it three different names. This fraud was pointed out by Professor Rütimeyer in *Archiv für Anthropologie,* Bd. III, s. 301. Professor His remarks that one would expect a retraction and excuse for the mistake; but no. 'Instead of this Haeckel in the preface of his later editions heaped heavy insults on Professor Rütimeyer, equally untrue in their substance as dishonorable in their form' (p. 169). He however saw fit to omit the duplicates. But the exposure did him no good. Professor His tells us that in the fifth edition of the same work of Haeckel's there is a copy from Bischoff of the figure of an embryo of a dog and from Ecker of one of a human embryo, both assumed to be of four weeks. He points out certain peculiarities of these 'copies' well worthy of notice 'or,' he asks, 'is it through a mistake of the lithographer that in Haeckel's dog embryo, precisely the frontal part of the head is three and one-half millimetres longer than Bischoff's, but in the human embryo the forehead is shortened by two millimetres, and at the same time, by the pushing forward of the eye, made narrower by fully five millimetres?' In short, what purported to be copies of figures by leading authorities and respectable men were falsifications made to show a similarity which does not exist between the embryos of man and dog. His then points out other false dealings by Haeckel in the matter of illustrations, some of which he declares to have been invented (erfunden), and remarks very justly that this play with facts is far more dangerous than his play with words, inasmuch as it requires an expert to denounce it. He charges that Haeckel well knew the influence that he exercised on a large circle. 'Let then others honor Haeckel as an efficient and reckless party leader; according to my judgment he has forfeited through his methods of fighting even the right to be counted as an equal in the company of serious investigators' (p. 171). There is

is the only reason why he is mentioned here, and our footnote shows where the evidence of his falsifications is to be found.

It is very easy to assume that a man who commits a murder must be a very evil personage, while one who teaches a false doctrine is only an imbecile. We *think* no one will believe such a teacher, but we forget that the murderer is nowhere nearly as bad as he who teaches erroneously,—for the murderer kills but one or two individuals. The teacher who falsely instructs, let us suppose he has only one class of ten pupils each year and that he teaches twenty years (making a total of two hundred individuals, who, marrying, will add two hundred more people to the list, and as families average about three children this will make six hundred more,

only to add that Haeckel, in spite of plenty of subsequent exposures, has not reformed his ways," (pp. 22-23; *Thoughts of a Catholic Anatomist,* by Thomas Dwight, M.D., LL.D. Longmans, Green & Co., 1912.)

And in a note Dr. Dwight adds, "If any one would know what the late Alexander Agassiz, whom we all honor as a scholar and a gentleman thought of Haeckel, let him consult Agassiz' report on the expedition of the 'Albatross' in the *Bulletin of the Museum of Comparative Zoology,* at Harvard College, Vol. XXIII, 1892, p. 32 to p. 40. His tone is not that of one arguing with an equal, but of one exposing a knave."

See also, "Facts and Theories," by Sir Bertram Windle, M.A., M.D., Sc.D., LL.D., F.R.S., K.S.G., Published by Herder, 1916, pages 18 to 27, on 'Bias', who quotes Sir Oliver Lodge, F.R.S., "Life and Matter." "He (i.e. Haeckel) writes in so forcible and positive and determined a fashion from the vantage-ground of scientific knowledge, that he exerts an undue influence on the uncultured amongst his readers, and causes them to fancy that only benighted fools or credulous dupes can really disagree with the historical criticisms, the speculative opinions, and philosophical; or perhaps unphilosophical, conjectures thus powerfully set forth." (p.135.)

Also refer for an account of Haeckel's falsifications to "Brass and Gemelli, *L'Origine dell 'Uomo e le Falsificazioni di E. Haeckel;* also Wasmann, *Modern Biology and the Problem of Evolution* (inter alia., pp. 511, seq.). See also Gerard, *The Old Riddle and the Newest Answer."*

Our object in giving this lengthy note is this, that although Haeckel's work has often been objected to, it was rather difficult for the average reader to point directly to the very page and place where these falsifications could be found, and to cite his authorities.

or one thousand people who will be affected in one generation alone by a single teacher), will through the years affect a great number of people, who, in their turn, will teach others what is false, making a never ending chain; and, as most men cannot think without putting their thoughts into practice, it can easily be seen that many, many murders as well as other crimes can be traced to nothing else but erroneous principles inculcated during the plastic period of life. It is for this reason that so much argument has been spent on whether man descended from one of the lower animals or not. This is really the crux of the whole matter with moralists, for if the *only evidence* that man had for assuming that he was especially created was, let us say, the *bible*, and he believes that the bible is the *sole* rule of faith, there is only one outcome for such a man, and woe be unto him and his children if they attend any of our schools now, for such a child brought up to accept such a theory gets his only validity for his morals from the one fact alone, that the bible teaches him his code of action. If it can be demonstrated that man was not created in exactly the way this particular individual has pictured it to himself, then all the ground is taken from under his feet, and, having no further evidence for his original belief, because the bible and the bible only was his sole rule of faith, he has no moral code left him, and so it must follow that, in accordance with this reasoning, that man not having been originally created a full-fledged man, there is no evidence that any of the rest of the matter contained in the scriptures is true, and consequently he rejects consistently the moral precepts as well. Again, if he is at all reasonable, he can also see that if man is but a piece of protoplasm, highly developed,—only a little more developed than other animals,—there can be no reason whatever for his not accumulating all the pleasure and wealth possible, caring nothing at all about what it

costs his fellow-man. It is for this reason that those who opposed one of the evolutionary theories, namely, that man descended from an animal ancestor, became so violent at times, and it is for this reason that we still hear so much of its echoes, about Science and Religion, or Science vs. Religion, or Science and Faith, etc. The upholders of the descent doctrine *felt* no different morally, as a rule, than they had before they defended it, because they had the inheritance in all its fullness of their moral code, and had trained themselves in accord therewith, so that in as much as they had passed the plastic period of their lives, they could not understand how men could think that descending from the animal world could destroy morality; but their children, and men at large—the great majority—being untrained in what it all meant, could only know this, that the bible in which they had placed infinite confidence was torn away from them. There are very few human beings who can stand alone mentally or morally. Nearly all seek assistance and desire to lean upon the theories of some tangible philosophy of life, and pinning their faith without rhyme or reason to some man who is an interesting writer or speaker (though by no means necessarily a scientist) they feel that as they have lost the philosophy of life they formerly held, they must follow him who was instrumental in bringing about that loss. Having, then, come into an atmosphere where no moral training at all is given, there are no distinct ideas of what morality means and, as it is perfectly true that in and of itself no act is either good or bad if no law can be apprehended (for only a law can possibly tell good and bad in the moral order), there is no reason why men should not follow every impulse that tends to give pleasure, regardless of what it might cost others.

We are here using the term "law" as an expressed or

implied statute given by one who has authority to give and enforce that law in conscience. We are not speaking of a physical law or of a statute made by a community.

The French Revolution brings home an example of what we are trying to make clear. The writers of that day taught that the people were supreme—that there was no higher power. Now it is well known that the great mass of mankind will, whenever they have a thought, try to put that thought into action—in other words, men cannot *only* think, they must act out their thoughts and in the example of the French Revolution we see what terrible bloodshed resulted from carrying out the thoughts which the writers of that day propounded. This is the direct result of the doctrine that there is no power of absolute authority above the people, which means, of course, that, the people being supreme, everything they do *must be right*. Will any contend that the murder of thousands as accomplished during this reign of terror was right? No one was to blame for it but those teachers who taught these false doctrines and inflamed men's minds to fury. This is but one of many examples of what the erroneous teacher does. His crime lives on to poison thousands, while the individual criminal injures only himself and the few on whom the immediate injury is inflicted.

If what is taught matters so much, one can understand why those of broader vision see the results long before their occurrence and begin fighting them, usually only to be condemned by their contemporaries. We *now* condemn the burning of witches, but do not think that there weren't men and women of the past who also condemned the practice. But others had power for the time being, and as always, the passing years have shown most conclusively that those who saw farther than their neighbors were *right* but unpopular,

while the most popular teaching was entirely in error.

If, then, every thought, every idea, everything that has changed the history of the world, is but a series of thoughts built up from some few facts into a meaningful whole, it behooves man to study that most important of all subjects by which he may test himself and try out his reasoning, and check himself up, so he may feel reasonably assured intellectually that he is correct in his findings, and, *not only "feel"* he is right; and to do this, he *must* study Logic.

An example that illustrates this chapter comes to mind from the pages of history. Cardinal Richelieu, the great minister of France under Louis XIII, fought the Protestants in his country with extreme vigor. *This is a fact.* None will deny it. Now to know *that much* without having several additional facts would lead one into erroneous conclusions, for, it *could be said*, that as Richelieu was a Catholic he might wish to exterminate those who were of another belief. But—and here we show that *additional observations make considerable difference* (bear in mind, not on the first fact, but) *on the conclusion.* We also learn that Gustavos Adolphus, King of Sweden and a Protestant, was assisted by Cardinal Richelieu in exterminating the Catholics of that country. *Now we may draw other conclusions.* But with only these facts before us, we are still at a loss. So we need a broader view of the whole range of the times. This is what we mean when we say that the isolated facts gathered by the special sciences must be woven into a complete whole before they give that true insight into what it is all worth, and what it all means. And we must know all this before we can pass a valid judgment on Life, and, after all, that is what our studies are for, and just in so far as we fail to do that which we are attempting, we are failures.

To read further in history then, we easily see that the

Church and the State had been most intimately interwoven; in fact so much so that it was almost impossible for men of that day to concede that a state could exist without such union. *We* have grown accustomed to the separation—we have been born into it all, and so it seems a matter of course to us, but it was all so different to these men who never even dreamed such things possible. Religion and Politics meant almost the same thing, or, we may say, two sides of the same question, and so Religion had nothing whatever to do with what Cardinal Richelieu did. It was politics pure and simple. The Catholics were the political party in power in France. The Protestants were similarly the political power in Sweden and one reigning house helped the other. This, then, changes our entire conclusion, though it is based on exactly the selfsame facts with a little broader knowledge.

And the argument would run something like this, among men who know nothing about the matter, except one of the facts mentioned: "Well, isn't it a *fact* that Cardinal Richelieu killed the Protestants, at least all he could?" And the one to whom the question is addressed admits it, when the answer comes quite regularly as it always does in such cases, "Well, then, where's the argument? Doesn't that *prove* my point that he was a narrow-minded bigot, and would even resort to murder to get rid of his religious opponents?" Let the reader judge whether it proves the point or not, and see for himself what value Logic may have for him in one of the many like predicaments in which he so often finds himself and in which without it he cannot meet his opponent's "facts."

CHAPTER VI

THE PRESENT STATUS OF EVOLUTIONARY PHILOSOPHY

ALL that we are and all that we can be is summed up in what Inheritance plus Environment in its widest application determines what each shall and must be. And if this be true, and none will deny it, Evolution is one of the most insistent and important factors with which we have to deal, for, since Evolution has come into our schools, and it has been there for over a generation now it has not only revolutionized our educational system, but there is no department of human study, from theology to stock-breeding, that has not been materially affected by it—in other words, Evolution has reversed our educational viewpoint entirely.

The thing that Darwin did in 1859, by the publication of his epoch-making book, *The Origin of Species*, was the turning over of our educational system. This is the all-important fact to remember and the one on which all the stress is to be laid.

Up to that time men were interested in *dividing* and *separating* everything and anything into separate camps—into separate species—into separate families and groups of various kinds. *After that time* just exactly the reverse viewpoint was stressed, namely, that in all learning, the object sought for was the connecting link which should bind all things together. And if there be anything of *most* importance in one's study, it is the viewpoint with which one starts and which so thoroughly and indelibly colors all

one's findings.

The story is told of a missionary and a hunter meeting at a mutual friend's home, both being surprised to find that each had been in the same region of Africa during the same period. The hunter expressed his amazement at their not having met before, but the missionary immediately asked whether the hunter had met *any* missionaries during his African sojourn; receiving a negative answer, he continued, "Well, I presume you saw any number of lions and tigers?" The hunter admitted that he had, to which the clergyman made answer, "Yes, you were looking for lions and tigers. I, however, saw none of these during my fifteen years' work in the region, but I did see any quantity of missionaries, for I was looking for them. We each found exactly what we were looking for."

This psychological point is so often lost sight of in scientific investigations. So many students forget that facts, *in and of themselves*, are of no value, for which reason Dr. Oliver Wendell Holmes said that if there was any one thing that never made an impression upon him, it was a "fact." It is the *meanings*—the interpretations of the facts that count—not the facts themselves. Facts are only the foundation stones on which to build.

Walter Bagehot probably also had this beginning viewpoint (we may term it) in mind, when he said that the moment a man becomes famous he also becomes a nuisance, for he carries so many of his earlier prejudices over into the maturer life with him. And, of course, by virtue of his position, does untold damage, for most men assume that if an individual knows much of one thing, even though that be but one of the minor details of life, he must likewise be an authority on all other things, even though, about these other things he may not only be ignorant, but, what

is worse, hopelessly prejudiced—a condition due to that ignorance.

For this reason also we find nearly every volume written on such a subject as Evolution, either giving only the points that help to bolster up the particular theory the writer upholds, or the particular points that demolish or attempt to demolish an opponent. To read a book of this kind, and even to follow out all the references cited, only strengthens one's prejudices, for it is self-evident that in the writing of such a volume the author has only given the references to those writers who hold largely with himself, instead of showing the various viewpoints of opposing workers in his particular field.

To have read a volume, then, no matter by whom, and no matter how worthy in itself—to have followed every reference stated—to have read every volume in the bibliography cited, may very easily mean a *narrowing* instead of a *broadening* to the one who reads. It is most essential that the reading be done on both sides, not so much to realize that there are opponents, for every theory can produce these, but to obtain perspective—to be able to stand far enough away so that the battle cries of each opposing force may be heard and weighed and, above all, to realize how the *very same facts* can produce such *totally different conclusions*. It must not be forgotten that the facts are not disputed—all the arguments and wranglings come from what these facts mean, and meanings are and must always remain in the realm of philosophy—that is, they must be *logically* drawn. On this point also there is no dispute. All writers admit the necessity of logic, though by no means all use it.

Let us observe, then, the various viewpoints with which men begin their science: the theologian, starting with the

idea of a God and a separate creation, insists that his facts be interpreted in the light of such a premise, while the opposing force may be well illustrated by the lines of Professor Vernon Kellogg in discussing a theory (and that by a non-theologian), when he says, "Nägeli's automatic perfecting principle is an impossibility to the thorough-going evolutionist seeking for a causo-mechanical explanation of change."

Of course it is. Starting with the *idea* or *premise* that all things *must* be explained by a causo-mechanical action, *is just as valid and just as invalid as starting with the theologian's viewpoint.* If that is the idea with which one wishes to start, and if, as here implied, everything is to be thrown out that does not fit in with such a theory, one can readily see that there isn't any *science* about it at all. It is simply reaching up in the air and picking out a starting point that is more or less agreeable to the one doing the reaching. And yet, perfectly obvious as all this appears, the writer has hardly met a single student at any of the schools where he has studied, who even remotely thought of this.

To the student thoroughly ingrained with the idea that the bible is to be used as a text for every subject under the sun, this has become so part and parcel of him, that he does not know that he has never found a reason or justification for his viewpoint. He has simply been among people who have always considered this viewpoint true, and consequently he has accepted it. But is there any more reason why this man, so unscientific, is to be condemned than he who takes the causo-mechanical viewpoint simply because he has been thrown in an atmosphere of those who hold *it* and, finding these men in whom he has confidence, upholding that doctrine, he, without rhyme or reason, accepts it, just as did the

biblical acceptor? It is just this point that must be impressed upon the student and it is here he must be shown the value of Epistemology and Metaphysics. It is this lack of *valid reasons* for the Beginnings or starting point of most laboratory men, that separates people at large into *camps of thinkers and camps of observers*, both with a mutual distrust of each other—with an undercurrent of smiling indulgence and tolerance, but implied contempt of one side for the other, and which to the writer's mind is hazardous to the student's true conception of either observation or philosophy.

The very surfeit of examples that come to mind must be culled, and only one produced to bring home this most vital and important feature. In the Unpopular Review of about a year ago, in a series of articles on Psychical Research, the author quotes Professor Wm. James' discussion with a well-known psychologist who insisted that, even if a psychic force could be found, it should be denied by all scientists, as it would throw into disrepute so many theories that are now held necessary for scientific explanations.

When it is thoroughly realized by students that all of our science rests on *theories* which in turn can only be held by *accepting certain unprovable first principles*, a different viewpoint will be had. This fact is brought home in the passage from Professor Kellogg, where he says, in speaking of both Darwinism and an opposing theorist, that "after all the Darwinian interpretation is proved only in so far as it possesses a high degree of plausibility and makes a convincing appeal to our reason. Of exact proof, in the nature of observed fact or result of experiment, or of mathematical demonstration, there is little in the case either of the Darwinian or the Korschinskian interpretation." [1]

[1]Darwinism To-day, by Vernon L. Kellogg.

Professor Kellogg is a very thorough-going evolutionist, and his book *Darwinism To-day* from which we shall quote in this chapter in so far as it pertains to the purpose in hand, is a masterful summary of the various systems and theories of evolution so far propounded, though furnishing no proof, as usual, for *logical beginnings*, while yet saying very definitely that "the *evidence* for descent is of *satisfying* but *purely logical character*." The italics are ours.

And, speaking of intemperate anti-Darwinians as he does, it seems hardly just that such an intemperate paragraph as the following should come from the pen of one who so heartily condemns the very thing of which he himself is guilty.

Now all these millions of kinds of animals and plants can have had an origin in some one of but three ways; they have come into existence spontaneously, they have been specially created by some supernatural power, or they have descended one from the other in many-branching series by gradual transformation. There is absolutely no scientific evidence for either of the first two ways; there is much scientific evidence for the last way. There is left for the scientific man, then, solely the last; that is, the method of descent. The theory of descent (with which phrase organic evolution may be practically held as a synonym is, then, simply the declaration that the various living as well as the now extinct species of organisms are descended from one another and from common ancestors. It is the explanation of the origin of species accepted in the science of biology. (The natural question about *first* species or the first several, if they appeared simultaneously, will receive attention later; the theory of descent explains the origin of kinds of life, not the origin of life.) If such a summary disposal of the theories of spontaneous generation and divine creation is too repugnant to my readers to meet with toleration, then, as Delage has pertinently said in connection with a similar statement in his great tome on "Heredity," my book and

such readers had better immediately part company; we do not speak the same language. (Page 11.)

In other words, he might just as well have made it much shorter and said, "As long as this is MY starting point that's all there is to it. It must be right because it is mine. There is absolutely no proof needed to establish my premise. I have said it. Take it or leave it, but *I'm right.*"

It can very readily be seen that any other kind of a beginning would be just as valid and just as absurd, if no further facts than these were brought for evidence. It would be a little fairer probably to put it in still another way, and this is really the accepted viewpoint in some scientific circles—that, though there are those who differ from us, we are going to accept as our starting point a causo-mechanical explanation, and everything which does not fit in with this theory is to be discarded, and all those who do not accept this statement are unscientific, superstitious, and incapable of being scientists anyway, so we might as well come to an understanding now. You who do not accept this theory are wrong, for we must be right.

Again let us notice the philosophical regions drawn upon when proof is needed, but rejected when proof is demanded by those outside the causo-mechanist's fold for the very causo-mechanical theory upon which all the later building rests.

What may for the moment detain us, however, is a reference to the curiously nearly completely *subjective character* of the evidence for both the theory of descent and natural selection. (Page 18.) The italics are ours.

We wish the reader to understand fully and completely, as most of our college students do not, what the *evidences* for the various theories of Evolution are. And we have used

Professor Kellogg's volume because it is a sort of classic in the biological world and is read and recommended in probably most, if not all of our schools to-day. We are not using it as a text, but as a worthy reference work, so that the causo-mechanists may be represented by one of their accepted writers. And we are trying to impress upon the reader the *fact* that *all* the *evidence is logical;* this being so, every theory must fall flat that cannot be upheld by that selfsame logic that is invoked as evidence.

We must here differentiate between "True" and "Logical." To get at the truth of anything, ALL THE FACTS must be known, and we must be able to PROVE OUR PREMISE. But to be logical means only to argue in accordance with the rules of logic from a premise already accepted, regardless of whether that premise be false or true.

Further, it requires no biologist to show the fallacy of an argument, but a logician, though conversely, it does not require a logician but a biologist, with a very considerable knowledge of his own and related sciences *to formulate a biological theory that is of value,* though he must of course know his logic also. This is well put by Herbert Spencer when he says:

Judging whether another proves his position is a widely different thing from proving your own. To establish a general law requires an extensive knowledge of the phenomena to be generalized; but to decide whether an alleged general law is established by the evidence assigned merely requires an adequate reasoning faculty. Especially is such the case when the premises do *not* warrant the conclusion.

With all these facts before us, we may say that if we accept the facts that laboratory men have found, and use our logic in analyzing and deducing therefrom, any man capable of reasoning may show where errors creep in.

In other words, the recluse in his cell is just as capable of this as is the best observer that ever lived, so that it seems strange that Professor Kellogg should permit the following statement to appear on the pages of his book:

I have however, assiduously sought out (with the help of librarians and my indefatigable Leipzig book-dealer friend Bernh. Liebisch), and perused the original pourings-forth of criticism and villification even to the reading of some matter written by certain Roman Catholic priests with a considerable amateur interest in natural history and a strong professional interest in anti-Darwinism! (p. 30).

The implication here being that if any one happens to have a decided leaning away from a preferred interpretation, one's writings are worthless, for no other reason than that one's leanings are not those of the particular author's; and most heinous of all offenses is the fact that one does not make his living by the matter under discussion—that is, is not a professional—for that is all the word amateur means, though by implication it means much more and is a subtle way of poisoning especially youthful minds. Would it not be just as fair to ask how Professor Kellogg who has a very decided leaning away from the majority of anti-Darwinians, by that leaning, could pass a valid judgment on them?

It would seem that the whole matter rests on an equal footing, but surely if a fact be a fact, it ought still to be a fact whether found by a Roman Catholic Priest, or by any other amateur, or by Professor Kellogg; and by way of passing, it might be suggested that of all *biologist's names* contained in the eleventh edition of the Encyclopedia Britannica, the Abbot Mendel, a Roman Catholic priest and *amateur* scientist, occupies the greatest quantity of space, and when one realizes that Father Mendel was an Aus-

trian—that is, was German—and the British national pride is considered, if with all this in mind we find an English book compiled by the leading scientific University of England, giving him more space for a description of himself and work than any other biologist that ever lived, it might even imply that he deserved still more credit than was given him. And in the realm of insect life and evolutionary philosophy Father Erich Wasmann, another German Roman Catholic priest and amateur scientist, is one of the best known and ablest of men. This is practically acknowledged by Professor Kellogg, but what we are trying to drive home is that even where an acknowledgment of this nature is made, implications that are subtle and invidious, poison the mind of our students, making them neither scientists nor philosophers. We must give them freely, frankly and openly the evidences as they are. We must have them obtain perspective, and have sufficient background; then, and then only, can they understand the necessity for constant watchfulness to prevent emotionalism and desire from overpowering logical judgment.

We wish, then, with this foreword to give a sort of synopsis of the various theories of Evolution, for it is well known that the average college man and woman of to-day accepts Evolution, *but does not know why.* Ask the first dozen you meet and note the conflicting answers. So we shall attempt to define what we mean by the terms we are using, especially the two most in evidence, namely, "evolution" and "species." It must be admitted that these two terms carry such different significance to different people that probably no two students from two different colleges would get the same meaning out of a volume containing them. This explains why, often, the argument as used by an author may be true while in reality the whole theory may be false, for

the *facts* do actually demonstrate that the thing one man means by "species" is actually produced from the same common parent, while in the other sense of the word it is not and cannot be demonstrated, for the very definition of the word forbids such possibility. We may say, then, that the *same fact* may give rise to any number of theories as to how that fact came to be what it is; we may further say that until we have *all* the facts we have not the *truth*, and any fact may change our interpretation, and then we may even go further and say that by meaning a different thing by the same word, the *same fact* may not be the same fact at all, but found by two different people, each one assuming the other means exactly what he does by his terms, each has called two different facts by the same name.

Professor Kellogg defines Evolution as being synonymous with the theory of descent in the plant and animal world—that is,

> The various living as well as now extinct species of organisms are descended from one another and from common ancestors. (p. 11.)

Bear in mind that this says nothing about FIRST forms. Something has evolved, but we are not told WHAT it was that evolved, nor is there any agreement among biologists themselves as to HOW it all occurred. All the *theories* of Evolution are attempts to tell us HOW things came to be what they are. But what we are prone to forget is that we have to have something to evolve before it can begin evolving. That is, Evolution attempts to explain only HOW the many species of plants and animals we now have came to be what they are.

It is a very decided dictum in science *now* that no life can come from anything non-living. We have living things

on the earth *now*. We all know it was not always so. Life, then, *must* have come from the non-living at some time. There is, of course, not one vestige of observational or experimental proof. All we have is our logic to fall back on, and this tells us that no science or knowledge of importance is possible unless we have a continuity of the action of what are termed laws of nature, but we have just shown that the laws of nature are not now what they have been, so we have nothing left but the two remaining theories Professor Kellogg cites—Creation and Evolution. But even accepting Evolution, as we do, it surely is not an *alternative* as the book quoted states, but both are pretty nearly the same thing, for in the one case it is implied that Creation must mean every given thing was created just exactly as it is to-day, and in the other that changes have come about throughout the ages which, however, still leaves us in the dark in regard to the first forms that evolved.

This latter problem is just as unsettled now as it has ever been. All the whole argument does is to drive the matter back a little further—it doesn't change anything at all. But those who object to the causo-mechanical way of thought, suggest that as all the evidence its defenders have, is logical, they must be logical to the very end, and adhere to their own principles and, assuming as they do, that nothing occurs without a cause, then if there be any value in their arguments they must admit a first cause and define and explain that. This they fail to do.

But this is what they *must* do to live up to the very principles they themselves have laid down, and if they do come to this conclusion, as many of them now have, it means that the cause which conditions what we are and what we can evolve into, is an inner driving force, as Nägeli has well shown and as the growing school of Neo-Vitalists

are constantly insisting upon. We must come to this conclusion, and even the causo-mechanists who are still stern in their faith of a causo-mechanical explanation of things are running dangerously near the shoals with their orthogenetic theories that most of them have now included among the factors of organic evolution. These theories will be explained a little farther on, here we wish to stress important points that mean everything in the study of any science.

By Evolution then we mean this and this *only*, that *some* present-day forms of plants and animals are different from their parents, and sufficiently different to consider them thoroughly unlike their parents, or at least unlike some more distant ancestor. In other words, a present-day form of plant or animal need not necessarily have had ancestors that were just like itself.

That is all Evolution means. We must not confuse this word with a THEORY of Evolution. This latter is an explanation of HOW this change mentioned came about, and nearly every worker has one or more pet theories of his own. Evolution must not be confused with Darwinism, for the latter is only *one* of the Theories of Evolution.

Now to explain what is meant by SPECIES. It is safe to say that, taken by and large, there are really two viewpoints in this matter, one, that so long as plants or animals can interbreed do they belong to the same species, provided they give birth in turn to fertile and similar possible-interbreeding offspring. That no matter what difference there might be in appearance, such as having one more or less stripe; or a different shade of color, the general form and type is always true, and these are true species. Any decided change in make-up or appearance among such interbreeding types these men would call "variations" and the

plant or animal possessing these variations would be known as "varieties." Of course, one can readily see that there would be and could be no possibility of new species arising under such a definition, for every parent form would always be the "Species" and any variation from such parent would not be a Species but a "Variety." This being so, it is most essential that one ascertain what any given author means by the term, before passing judgment.

Those opposing, define Species as being any decided difference that is carried down from parent to offspring and displayed in the physical form of such offspring. And in accordance with this explanation there is some evidence that new Species *are* formed.

The evidences for Evolution are drawn primarily from the fossil remains of ancient forms now extinct; from the life of plants and animals before birth (embryology); from comparative anatomy, physiology and the related sciences.

Accepting as a fact that we have some evidence for the formation of new species, in accordance with the second definition given above, the question arises as to whether ALL present forms are different from their parent forms and the still more important query will not be banished, as to whether all of these forms came from ONE SINGLE parent form, or whether the animals came from a common ancestor, the plants from a common ancestor, or both from a common ancestor, or whether each had a particular parent form somewhere in the dim, distant past, and last but of most vital importance can Mind ever come from Matter—can man's intellect have arisen by mere physical accretion?

And we must not forget that St. Augustine, many centuries ago, suggested the possibility of Evolution[2] and

[2]See Augustinism in History, Catholic Encyclopedia, under V. St. Augustine of Hippo.

Lamarck and Geoffrey St. Hilaire did likewise about a half century before Darwin's time, but they obtained no very ardent disciples to carry forward their work and so the world had to wait until the arrival of Charles Darwin to have its principles accepted by the schools at large. And here an interesting observation may be made, that Darwinism is a *Theory* of *How Evolution came about*, and while Evolution is stronger in its entrenchments now than ever before, Darwinism is constantly losing ground, as we shall presently show.[3]

Darwinism means that principally if not entirely, Natural Selection is the cause of the *origin* of species, but as will be shown, Natural Selection can only kill off plants and animals and can never originate anything, so that even the title of Darwin's volume, "The Origin of Species," is a misnomer.

All too often men give a description of a phenomenon, call it by a name, and assume they have explained it, *but* there is a world of difference between a description and an explanation.

And lastly an important factor appears in that we may ask whether or not, as many now hold, most forms would not have evolved just as they have regardless of all external factors. If that is true, there is an *inner something*

[3]It is interesting to note that Professor Huxley was not himself convinced of the theory he constantly and most valiently defended, though as Professor Poulton says he believed so thoroughly in fairness that he would take up a defense of a thing just to oppose unfairness. See Huxley Memorial Lectures to the University of Birmingham (1904-1912). (Cornish Bros. Ltd., 1914) as reviewed in Vol. XIII, Page 924, The Hibbert Journal. "Professor E. B. Poulton discussing in the second lecture of Huxley's relation to the theory of Natural Selection, says one or two things which will be new to the ordinary reader. 'Although no one fought so nobly, and against such odds, in its favour, although no one had ever fought the battle of science with such success, he was never a convinced believer in the theory (Natural Selection) he defended from unfair attacks' (p. 45)."

in the plant and animal, that determines to a large extent what it is to become. This is the growing view of most biologists and this theory is called Orthogenesis. The further question presents itself, is there any *purpose* in what is done, or is it all merely accidental and promiscuous? And this, Teleology answers.

Having covered the field swiftly and shortly, we may add, that the remaining point to be covered is whether or not in its *application* Evolution must cover all living things or is limited? Does it apply to the human family? Is there any difference between the lower animals and the human being sufficient to be able to state definitely and convincingly that they could not have been related at any time past? And we must note this point, that the whole argument rests on the similarity in the *physical* bodies of man and the lower animals among those who uphold this viewpoint, and on the great difference in the mental portions of the two, among those who take the opposite side of the question. And it is more than interesting to observe that nearly all of our animal psychologists and our human psychologists, by constant observation and thorough experimentation, have come to the conclusion that there is an unfathomable difference between the two. It is almost universally agreed that animals work entirely by instinct and association, and human beings, though working largely by instinct also, may, however, use reason. Somewhere Professor Wm. Wundt, the greatest living Experimental Psychologist, has said Animals never reason, Humans but seldom. This immense difference in the mental realm, together with man's speech, separates man entirely from the brute world.[4]

[4]John B. Watson's Behavior, An Introduction to Comparative Psychology.

Summing up, then, we may say that Evolution means that *some* present-day forms of living things come from dissimilar ancestral forms, many intervening forms having during the years become extinct so that we cannot trace connections between those of the present day and these extinct ancestors.

That the evidence for this belief is not absolute, but purely *logical.*

That "It is necessary, even in the study of the Natural Sciences to have something of the nature of a creed, an abiding belief in some fixed principle, which may regulate and give coherence to the mass of information and ideas which we accumulate in the course of our studies. Without such a belief to guide us we embark on our journey of investigation without rudder, compass, or pilot.

"In those sciences which occupy themselves with the explanation of the existing order of things on the earth, the fundamental beliefs are, firstly, that the course of Nature has been uniform—that is to say, that in past times the same forces have operated, possibly with varying intensities, but always in the same manner as those that are in operation to-day. Secondly, that which is, is the outcome of that which has been, and is the forerunner of that which will be. The history of the world and its inhabitants presents itself to our imaginations as an unbroken series of successive states, each differing somewhat from its predecessor and successor, but as truly derived from its predecessor as the child is derived from its parent, and as truly the antecedent of its successor as the parent is the antecedent of the child. This belief is what we express by the word *Evolution.*"

That we have accepted the conclusion even though the natural selection theory on which our conclusion was based has been thrown aside, and are now seeking new evidences.

'Comparative Anatomy of Animals, by Gilbert C. Bourne, M.A., D.Sc., F.R.S., F.L.S., F.Z.S. Vol. I, Page 1.

That the evidence we so far have, is drawn from many related sciences which up to the present has not been sufficiently stressed, for it is not generally known that the paleantologists favor one system of evolution, the pathologists another, the embryologists another, and so on.

That Darwinism is *only the name of one theory of how* evolution came about. It must not become confused with Evolution, and it is almost entirely discarded now, because it is absolutely unable to explain how a single species *originated.*

That it all depends on the Creed mentioned by Dr. Bourne, quoted above, as to what viewpoint one is to make use of to begin with. That is, whether one accepts the Theistic or the Causo-mechanical Creed and then insists on making his facts fit such preconceived idea of what he thinks ought to be.

That Evolution takes no account of the BEGINNINGS OF LIFE, but attempts only to explain what caused our present many types of plants and animals.

That the very continuity of which Dr. Bourne speaks is broken somewhere in that we have no life coming from lifeless matter now, and yet we know there was a time when there was no life on earth. We are forced to one of two alternatives, namely, that we must find a starting point for Life or we must acknowledge that we are starting in the middle of things with everything important unexplained and unexplainable, and, not knowing whether our hypothesis are then true, there being no ultimate starting point, we cannot know whether our conclusions are true.

That to be fair and honest with our students we *must* bring these matters home to them. We must show them that these beginnings rest with philosophy and that it is only as *practical* scientists that we are forced to do our work and "necessarily so, upon the principle that for all practical

purposes one is justified in using *any* assumption as a working hypothesis, if everything happens just as if it were true."

That while Evolution *is accepted*, it must not be confused with the various theories that have been brought forth to establish it, nor must it be *applied further* than the evidence warrants.

That the outstanding difference between man and brute is speech and rationality, a totally different kind of a difference than that existing between other animals or between plants and animals. Therefore no *application* of any *theory* of Evolution has yet been found that is accepted by biologists themselves, and as a consequence it is extremely hazardous and very unscientific to apply a theory still unproven to a condition which leaves out of question the very differences on which the distinction between brute and animal depend, remembering what has been said, that the theories of Evolution are based on the physical and not on the mental differences, and that all who have studied the mental in addition to the physical are inclined to accept this viewpoint.

That the Teleological argument has not lost its force, and that when such men as Nägeli, Driesch, and many others pre-eminent in their fields have come back to it, though starting from an opposite viewpoint and being convinced by the physical evidence alone, we can understand the reason why Orthogenesis is the most important factor now.

That nearly all biologists admit Orthogenesis in some form though they apply it differently, and feel, depending upon their prepossessions, that it possesses a varying worth.

And that, lastly, but of greatest importance, it depends on whether the premise with which one starts is true, for, if this should not be, there is little likelihood of erecting

a logical structure of worth thereon. In other words, shall we begin with just what is before us and insist that everything that does not look favorable to a Causo-mechanical explanation shall be cast aside, or shall we weigh and measure in truly scientific manner every detail, every thought and thing, coming from whomsoever it may, professional or amateur, so long as it be pertinent to the matter in hand, suspending our judgment until all the evidence is in?

CHAPTER VII

THEORIES OF EVOLUTION

REMEMBERING what was said in our chapter on the Present Status of Evolutionary Philosophy, we shall here consider very briefly the various theories which biologists have propounded to show HOW Evolution has come about, and, lest our interpretation of what the various theories actually mean be questioned, we have quoted the very words of one of their ablest defenders wherever possible.

In its modern aspect Lamarck and Geoffrey St. Hilaire were the founders of a theory, which was much more philosophical than was Charles Darwin's, in that it actually attempted to give an account of the reasons for the variations that we see all about us. Darwin merely accepted them and built his theory thereon. He made no attempt to explain WHY there are variations to start with.

Lamarck's theory may be simply stated by calling it the working out of the principle of "use and disuse." In other words, should an organ be used to any considerable extent it would become better developed than any other part of the body, or should it be used but little or not at all, it would atrophy, and this extra development, or this wasting away of the organ would be carried from parent to offspring, so that the offspring, again using the over-developed organ a little more, or neglecting the under-developed organ a little more, and carrying it on to its offspring in turn, would in the long run develop a race of in-

dividuals that would be distinguished from other races by this particular over-development or a particular under-development or entire loss of the organ in question.

Darwin accepted the transmission of acquired characteristics, as explained in the above paragraph, but attempted to explain HOW new species came into existence by Natural Selection. Probably a simple way of showing what was meant by this would be to give an example. Suppose some of us should journey to the Tropics to make our home; many would succumb to the fevers and other tropical diseases; however, *some would survive*, and these would produce offspring many of which would likewise perish, but, still, some of these would again survive, and so on, until there was left only the offspring of those who had been able to withstand the particular conditions there existing. After long years of such weeding out of those who could not withstand the ravages of tropical diseases, we should have a race that could live without any degree of uncomfortableness. And this principle would be called the "survival of the fittest," but as Professor Cope has well said, "Of course the fittest survive"; we all know that. This only tells us which ones do not die. And this is called Nature's way of selecting, but we can easily see that this does not tell us how anything *came into existence*—that is, it does not tell us anything at all about the *Origin* of Species. And this is what is meant by Darwinism, pure and simple—that the *Origin* of Species came about by Natural Selection. We must not forget, however, that while this is Darwinism, it is not Charles Darwin's doctrine; it was his disciples who carried it to the extreme. Darwin himself believed that while Natural Selection was the *main cause of the Origin of Species, it was not the* ONLY *one.* But we can readily see that in selecting *from what is already in existence* we can

only show *which survive*, but can never show how any new races originated.

And it is just this failure to do the very thing the name of the volume which sets forth these ideas, would lead one to believe was done; namely, to show "The *Origin* of Species," that has led to such widespread objection to the Darwinian idea of explaining anything except survivals. This is readily shown when such a lecture as "The Decline of Darwinism" [1] is delivered at an institution like the University of Chicago, and such a book appears as Professor Vernon Kellogg's *Darwinism To-day*. This volume, written by a man who is more than willing to render to the Darwinian side all and probably more than most men would be willing to render, and whose work is one of the recognized books of reference on this subject in the great universities, we shall use from which to quote in this chapter. We suggest a reading, however, of the entire volume so as to be able to see that Darwinism—that is, Natural Selection—has signally failed to show *how anything originated.*

Before entering into a detailed description of the many theories that have arisen to explain how Evolution comes about, we may call the reader's attention to the fact that, after all, they can be classed in two great divisions. First, the Darwinian, or Natural Selection plan, together with the many auxiliary ones that tend to support it, and second, an alternative type, which is intended to replace more or less entirely the selection theories.

In regard to the first, or Natural Selection theories, it must be remembered that in addition to the selection part

[1] The Decline of Darwinism, by Elliot Rowland Downing, Ph.D., Delivered during the Summer Session, 1914. See list of Public Lectures, for that Summer, published by the University of Chicago.

of the plan itself, there grew up also the idea that there was something adaptive about everything any living being did; i. e., any act or movement any plant or animal performed, was adapted to some end, and was useful to its possessor as a help in surviving. This does not mean that every action was done for a definite purpose, in the sense of "purpose" meaning in accordance with an intelligence situated outside of itself; but that, when any movement of any kind whatsoever was performed, the plant or animal performed it because it had a survival value, for, if it wasted its energy in movements that were not of actual service in survival, the one that did not waste such energy would quite naturally develop parts that the other one did not and thus become stronger and more able to survive.

Now, Lamarckism, or the principle of "use and disuse," would really explain most of these things better than Darwinism, but unfortunately for both theories Professor August Weismann, a most ardent Darwinian himself, investigated the matter and found that there was not a particle of experimental evidence to show that any acquired characteristic was ever transmitted from parent to offspring. To put this in other words, any change produced in the parent during his lifetime by his own efforts would not be given to the child; so, one might come from a race of blacksmiths, but the children of such over-developed muscular parents would not have any larger or better developed muscles than would a child from the same type and size of parents who had not developed their arms.

And as Professor Weismann was a sort of spokesman for the Darwinian school, his word is of more importance on their side than practically any other man, save Charles Darwin himself, and yet he had to admit that Natural Selection could not explain everything, and that it was un-

able to "initiate new lines of development or descent" (p. 189) [2] even going so far as to at least apparently approve of the orthogenetic viewpoint—which will shortly be explained—that when a particular development once started, it often kept right on even to the point of killing the organism itself.

Professor Weismann's other contributions are the idea of "Panmixia" which he, however, himself discarded, so we shall not enter into a discussion of it, and Germinal Selection, the latter being explained as follows: As the unit in the study of all biology is the CELL, and as every living thing from the lowest plant to the highest type of life in the animal world starts growth from a single cell, this single unit, only visible under the very high powers of the microscope, must have within its tiny self all the possibilities of producing the wonderful, complex structure that is later to develop. This being so, this tiny mass of protoplasm, as it is called, though looking so much alike under the microscope, must be made up of a very complex substance. To explain, then, how this little cell could reproduce such a wonderful structure as we see in adult forms of life he assumed that there must be thousands of little particles, each very elemental, and which he called biophors, and that these biophors unite in different kinds of groups and thus cause different types of later development. Professor Kellogg, commenting on this, says that each biologist seems to have made a theory for himself.

This is not all, however; there must be a further assumption of "determinants" for each *kind* of cell, but *not for each cell.* (There are certain definite *kinds of cells*

[2] Darwinism To-day, by Vernon L. Kellogg, Professor in Leland Stanford, Jr., University. Published by Henry Holt & Co., 1907. All pages mentioned are from this volume.

that go to make certain definite tissues in the body, and these tissues then unite to form organs, bones, skin, nerves, muscles, etc.) Remembering that there is a variation all through nature, no two blades of grass being exactly alike, so also no two atoms or molecules are exactly alike, and this being so, no two would get exactly the same quantity, or exactly the same quality of food, and the one waxing stronger would determine the greater strength of cells into which it would later develop. This food supply might be entirely fortuitous, but the determinants being in the Germ Cell will go from one generation to another. That is, there is here a something that is not an acquired characteristic, in the sense used above, of being due to some deliberate, or external, exercise or use, that over-developed some part of the individual and was then carried on; but, in view of the fact that we are what we are, simply on account of what we get from our parents—and as we know we *do* resemble our parents somewhat—whatever resemblance we may possess must come from the mere egg of the mother and sperm of the father, which of course forms the germ cell from which each individual develops, so that any change in the growth and movement and environment of the egg and sperm, will affect the germ cell from which we are built, and, in that way, whatever we are born with we get from our parents, and in this way we may account for the cause of any variation that we may have from our parents. This variation, however, would be along definitely fixed lines, and would have nothing to do with personal selection, because we cannot control the environment of ova and sperm. Natural Selection *then steps in and kills off those that cannot survive* the obstacles in a given locality or environment. But this very principle vitiates one of the principal arguments for Selection; namely, that it could establish new species.

To quote Professor Kellogg, this theory consists of two purely speculative basic assumptions: First, Weismann's particular theory of the ultimate structure of the germplasm; namely, the theory of biophors and determinants; and secondly, the assumption that there is a struggle for food among determinants. There is no proof of pure observation or experiment for the theory, and there is some proof directly against it. And yet the great need of a working hypothesis for the causo-mechanical explanation of determinate variation makes us give such a pure speculation more attention than it might otherwise get. Unfortunately the attention thus given to this particular theory seems to have resulted in the bringing forward of some rather serious objections to the possibility of the truth of the theory (p. 199).

Roux's theory, sometimes called the "battle of the parts," is based on somewhat similar lines to Weismann's theory of biophors, except that it does not assume tiny particles such as the biophors, but attempts to explain, by assuming a difference between outer and inner adaptiveness; the theory being primarily applied to the inner portion of the organism, and attempts to account for the marvelous adaptations there found. The competing parts in Roux's theory

are the chemical molecules composing the cells themselves, groups of tissues or cells, and even whole organs. The spurs to the competition for food are functional stimuli, whose result is to set up a special demand and necessity for more food (pp. 201-8).

This means that the determining factors are largely due to the "hazard of position," a part being more advantageously located receiving a greater stimulus to do more work, thereby gaining an advantage. The theory is in reality based on functional adaptiveness which Kellogg says

is proved, but not explained.

This idea of Roux's is like all the other theories propounded—held by some, and entirely rejected by others, and if we are to accept his theory it will mean we must accept the idea of the "inheritance of acquired characteristics" which is not held at present by practically any biologist, as all the evidence is against it. But Professor Kellogg considers it valuable because it does present "a mechanical explanation of the possibility of initiating certain fine and delicate inner adaptations" (p. 208). "Organic Selection" is the name of another theory, and means that by it we can explain why there are some acquired characteristics apparently transmitted by suggesting that ontogenetic selection (individual selection as contradistinguished from the selection principle applied to an entire race of plants or animals) may explain how each individual may be born with a tendency to vary; that is, there may be a congenital tendency to vary from the parent. Another way of putting it might be to say that the germ-plasm or egg cell from which the individual springs already possesses this tendency, and so, of course, the offspring receives the tendency, it being part of the germ-plasm itself. This *would not be acquired*, it will be observed, for *it was in the germ-plasm of the parents* and always descends, the parent himself being unable to change it. But the individual having such tendency may build thereon and thus make it show forth very definitely, and sometimes prominently, during life.

The causo-mechanists, however, reject this, for it is too much like assuming that there is some vital principle—some inner factor—that causes the tendency of which we have spoken, and this would be fatal to causo-mechanism. There remains in our first division of Natural Selection and

Auxiliary theories only the following then, which we have not yet discussed: Geographical, Sexual and Physiological theories, which, under a single grouping, are classified as ISOLATION THEORIES.

Professor Kellogg says: The varying importance attributed by different biologists to the theories explaining means and results of isolation is notable. While by some the species-forming influence of isolation is held to be as effective as selection itself—some deem it more effective,—others attach but little importance to it, indeed see no effects of consequence. These latter men are likely to be morphologists, cytologists, and laboratory men generally; the former are systematists, students of distribution, and so-called field naturalists (p. 232).

While he himself says he will take the middle path. Now all that is meant by isolation is, of course, that, due to various reasons, few or many, as the case may be, a given species of plant or animal being cut off from the rest of the same species (for example, by the sinking of a neck of land once existing between two continents, leaving part of the race in one region, part in another) that these, by inbreeding, will produce a type of individual that will probably be different from those which have not been so isolated, the particular environment allowing congenital variations to come forth in varying degrees. The non-geographical forms of isolation mean

some sort of segregation of individuals of the same species into groups inside of each of which mating takes place, and among which little or no cross-breeding occurs, because of varying habits, or unusual sexual aversion or attraction, or physiological or morphological variation affecting mating. For example . . . Plate points out that there are twelve species of albatrosses in the southern hemisphere, of which nine or ten belong to the Australian zoo-geographical

realm and intermingle throughout most of their range. At breeding time, however, these different species become segregated in restricted and separate localities so that mating is always accomplished among different individuals of the same species, although hybridisation could doubtless obtain successfully along these closely related albatross forms. Thus the species characters are kept pure: the species distinct (p. 243).

The theories now to be taken up are for the direct purpose of setting aside Darwinism; there are three general ones proposed by various biologists as substitutes for the Selection theories to account for evolution.

Lamarckism has already been touched upon, but as this theory requires the assumption of the inheritance of acquired characteristics and as we have seen that this is not accepted in the scientific world at present we shall not enter into any further explanation thereof.

The other two theories being those of Orthogenesis of Nägeli, Eimer, Jaeckel, and others, and

Heterogenesis suggested by von Kölliker, definitely formulated by Korschinsky, and most recently and importantly by de Vries. Few biologists would hold any of these theories to be exclusively alternative with natural selection; de Vries himself would restrict natural selection but little in its large and effective control or determination of the general course of descent. But all these theories offer distinctly substitutional methods of species-forming, and one of them includes certainly the most favored explanation, next to selection, of adaptation, while the authors or later upholders of some of them actually deny any constructive, that is, adaptional, species-forming or descent-controlling, influence of natural selection (p. 262).

One of the principal criticisms of the natural selection theory is that of the impossibility of explaining the beginnings of advantageous modification and the beginnings of

new organs, by the selection of fluctuating individual variation, and of explaining the apparent cases of the existence of determinate variation and the admitted cases of forthright development along fixed lines not apparently advantageous, and finally of explaining the definite cases of ultra-development of parts and species beyond the point of advantage even to such unfavorable degrees as lead to death and extinction (p. 274).

We have, then, Orthogenesis, which means only this, that there is a particular something that causes an organism, once it has started to follow a change along a certain path, to continue in that path, and *that path only*, even if it kills it to do so. Then there are several camps among the Orthogenetists themselves, Nägeli being a Vitalist, and assuming a vital principle that cannot be accounted for by any causo-mechanical force, and Eimer, who "finds orthogenesis produced and controlled by the directly working external factors of climate, food supply and environment generally."

In fact, probably a majority of biologists entertain a conviction,—often not clearly defined and generally unaccompanied by any satisfactory conception of a mechanism for achieving what they believe to exist,—of the actuality of an influence on organic modification and descent directly exerted by those various external factors or conditions of organic life which we call, collectively, *environment* (p. 277).

Nägeli's theory of orthogenesis depends upon the assumption of his so-called principle of progressive development (*Vervollkomungsprinzip*), a something inherent in the organic world which makes each organism in itself a force or factor making towards specialization, adaptation, that is, towards progressive evolution. Other authors who accept such a theory of an inherent driving force in organ-

isms speak of this factor variously as "an inner directive force," and "inner law of development," or an "intrinsic tendency toward progress," etc. Nägeli believes that animals and plants would have developed about as they have even had no struggle for existence taken place and the climatic and geologic conditions and changes been quite different from what they actually have been. Korschinsky says: "In order to explain the origin of higher forms out of lower it is necessary to assume in the organism a special tendency towards progress." That is, to be believers in this kind of theory of orthogenesis organic evolution has been and is now ruled by unknown inner forces inherent in organism, and has been independent of the influence of the outer world. The lines of evolution are immanent, unchangeable, and ever slowly stretch toward some ideal goal. It is needless to say that but few biologists confess to such a belief. However much in the dark we may be regarding the whole great secret of bionomics, however partial and fragmentary our knowledge of the processes and mechanism of evolution, such an assumption of a mystic, essentially teleologic force wholly independent of and dominating all the physico-chemical forces and influences that we do not know and the reactions and behavior of living matter to these influences which we are beginning to recognize and understand with some clearness and fulness—such a surrender of all our hardly won actual scientific knowledge in favor of an unknown, unproved, mystic, vital force, we are not prepared to make. As Plate well says, such a theory of orthogenesis is opposed, in sharpest contrast, to the very spirit of science (p. 278).

In other words, the latter part of this paragraph means simply that any assumption *that does not uphold this viewpoint*—the causo-mechanical—is unscientific and invalid—but any assumption that does uphold it is at least to be given the benefit of the doubt.

Eimer's theory may be said to be some determining law affected by environment or

evolution by natural selection would occur along all sorts of heterogeneous and radiating lines which is, according to Eimer, actually not the case. A few definite lines obtain from which occasional branches are given off, the whole building the familiar phyletic or genealogical tree. That these main lines and branches are not themselves the result of selection is proved by the fact that much evolution and modification of organisms is not directly useful, a majority, indeed, of the characters distinguishing different species not being characters of utility. Only when a character or line of evolution becomes of a life-and-death determining disadvantage can selection interfere with evolution by orthogenesis. And this interference is always and only of the nature of a stamping out, never of the character of the creation of new characters or lines. Eimer believes in the inheritance of acquired characters, believes in a considerable species-forming influence of geographical isolation, that is, finds such isolation very helpful to the general basic organic growth evolution principle and finds the actual causes of orthogenesis, "to lie in the effects of external influences, climate, nutrition, on the given constitution of the organism."

He denies positively any capacity on the part of natural selection to create species, finding it effective in breaking the continuous organic chain, that is, separating it into species, only when aided by geographical isolation. The actual species-forming, that is, the breaking up into specific units of the orthogenetic lines of change instituted by his dynamic factors, he finds to depend on three chief moments: viz., a standing still or cessation of development (*Entwicklungsstillstand*); a sudden development by leaps, called halmatogenesis (which is almost exactly the fundamental idea in Korschinsky's and de Vries's later heterogenesis theory); and, third, a hindrance or difficulty in reproduction (which is the essential factor in Romanes's theory of physiological selection proposed ten years later). It is of interest to note Eimer's claim to the original conception of species-forming both by heterogenesis and through physiological selection, with which two theories the names

of de Vries and Romanes, respectively, are commonly associated as those of the original proposers (pp. 282-283).

We should not omit mention, in connection with Eimer's theory of a point upon which he lays great stress, and that is that his theory is not the result of pure speculation, but is the unavoidable conclusion arrived at by long years of specific observations and study of the facts obtaining in the case of relations, conditions, and of course evolution of certain groups of organisms. Eimer made careful and extended studies of the wing-patterns of two large groups of butterflies, and of certain lizards and birds, and it is on the basis of these studies in particular that his theory is formulated. It is certainly to be admitted that his exhaustive and most suggestive account of the relations of species and patterns in the swallow-tailed and certain other butterflies makes a very strong argument against the validity of natural selection as an explanation of these conditions. And the example of Eimer's prolonged and minute study of actual facts as a basis for his theory and hypothesis building is one which has not always been followed by biological generalisers. It is to be regretted that the polemical and personal character of much of Eimer's writing has tended to make his whole work less regarded than it ought to be by biologists.

That Eimer's theory does not include in any degree the assumption of an inner directive or progressive force the following quotation from Eimer himself shows: "According to my investigations the chief cause of transformation (of species) is that determined definitive organic growth (organophysis) whose expression is a definite determined development (orthogenesis), which is imposed on the plasma by constant outer influences, climate, and nourishment. . . . Apart from the fact that the Nägelian assumption of a definite determined development is a hypothetical one, not proved by facts, the zoologist can hardly accept the existence of such a dominant inner factor ever pushing toward advance, when he recalls the host of regressive structures he has to see. This tendency to progress based on the assumption of 'inner growth laws' contradicts flatly the as-

sumption of outer influences as causes of change. . . . And it is my belief that it is precisely these outer influences, and the physiological phenomena dependent on them, which are the determining factors in the phyletic development just as they are in individual development" (pp. 284-285).

Recently Whitman, the Nestor of American Zoologists, has declared himself strongly as an adherent of the actuality of orthogenetic evolution. For many years Whitman has been studying variations and inheritance in pigeons, and through his work in particular he has become convinced that species-forming variation does advance in definite direction as well as in various directions. He says "natural selection, orthogenesis, and mutation appear to present fundamental contradictions; but I believe that each stands for truth, and reconciliation is not distant. The so-called mutations of Œnothera (Evening primrose) are indubitable facts; but two leading questions remain to be answered. First, are these mutations now appearing, as is agreed, independently of variation, nevertheless a production of variations that took place at an earlier period in the history of these plants? Secondly, if species can spring into existence at a single leap, without the assistance of cumulative variations, may they not also originate with such assistance? That variation does issue a new species, and that natural selection is a factor, though not the only factor, in determining results, is, in my opinion, as certain as grass grows, although we can not see it grow. Furthermore, I believe I have found indubitable evidence of species-forming variation in a definite direction (orthogenesis), and likewise of variations in various directions (amphigenesis). If I am not mistaken in this, the reconciliation for natural selection and orthogenesis is at hand" (pp. 288-289).

Jaeckel, the Berlin paleontologist, has formulated a theory that is a sort of transition between orthogenesis and heterogenesis, in that he believes that there is a definite orthogenetic progress among the race itself, but that individual species spring forth suddenly. These species at various

times, may sexually come to a standstill, and thus continue a definite race from thence forward (p. 289). Pfeffer follows somewhat along Nägeli's lines, in that he insists that

life consists of the capacity (more exactly exercise of this capacity) of consciously permitting and consciously influencing (that is, actually producing) through physico-chemical phenomena changes in the matter or form of the fundamental life-stuff (p. 320).

The theory of "heterogenesis," also called the "theory of mutations" or "saltations," and sometimes "discontinuous variations," takes its very latest ground largely from Professor Hugo de Vries, the Dutch botanist. Such names as von Kölliker, Galton, Dall, Bateson, Emery, Scott and Korschinsky deserve mention in connection with it also as de Vries was not the originator of theory. The Abbot Mendel as far back as 1865, six years after Darwin's "Origin of Species" was given to the world, published an account with some very logical conclusions thereon, in a little journal which was given out by the Brünn Natural History Society.

It was not until 1900 that three separate students of biology found this work of Mendel's and gave it to the world. Had those words of his been known a half century earlier, there is no doubt it would have changed much of our discussions on the "Origin of Species." And it is well to note here that when Professor Plate says that to accept a view such as Nägeli's we should have to give up so much that had been gained by hard-fought battles, and Professor Kellogg says that it is needless to say that not many biologists hold to Nägeli's views, it must not be forgotten that on matters of TRUTH it doesn't matter in the least

how many men hold it, for, if it be true, it remains such, regardless of a majority.

A newspaper clipping comes to mind of some years ago, when Dr. Robert Koch, of Vienna, was lecturing in this country. The reference is lost, but it comes to mind something like this: A convention for the study of tuberculosis had the famous bacteriologist lecture to it, and among other things he said, was that he was not yet positive, but in so far as his experiments had shown, he was inclined to believe tuberculosis from an infected cow would not be transmitted through milk. Objections were raised, and finally a vote was taken as to whether the doctor was right or not, the delegates voting him wrong. Of course that settled the matter! Disease was so carried, because it had been voted thus! It is just as reasonable to accept a thing because many men hold to it. The *evidence* is what we seek, and *not the vote.*

"Heterogenesis" is the theory with which de Vries's name is mostly associated and means that, sometimes (though not often), we have a freak, a monster, or "sport," as it is called, born from apparently perfectly normal parents and these sports then breed true and thus produce a new species.

Korschinsky, the Russian botanist, goes much further than does de Vries, who admits selection as a factor in evolution. Korschinsky

says plainly that the struggle for existence and selection have either no influence in species-forming and descent, or, if any, a hindering and antagonising influence, a retarding and nullifying influence (p. 333).

He has set down in parallel columns his views (pp. 334-335):

According to the transmutation theory:

1. To all organisms there belongs a capacity for variation which is called into play partly through inner, partly through outer causes, through use and disuse, etc. This capacity for variation regularly finds its expression in the appearance of slight and unnoticeable individual differences.

2. As a result of this struggle for existence and selection, those individual variations which prove themselves useful become fixed and accumulated, while the non-useful ones disappear. All characteristics and peculiarities of a species must, as a result of a prolonged selection, stand in harmony with the outer conditions, and be useful to the organism.

3. Through prolonged selection and accumulation of characteristics all species undergo a persistent change, whereby they are gradually transformed into new species without, however, sacrificing their normal physiological relations.

According to the theory of heterogenesis:

1. To all organisms there belongs a capacity for variation, which is a fundamental inner peculiarity independent of outer conditions, and which remains usually in the latent conditions, retained by heredity, but which now and then finds its expressions in sudden changes.

2. These sudden changes can, under favorable conditions, be the beginnings of persistent races. These new characteristics, having appeared independently of outer conditions, are sometimes useful to the organism, but they may also stand in no harmony with outer conditions.

3. All once-formed species remain unchanged, although new forms occasionally split off from them by heterogenesis. Such newly arisen forms have, as the result of a disturbed heredity, a deranged constitution, which reveals itself in a lessened fertility and often in a generally weakened condition of the

organism. The new forms, becoming constant r a c e s, gradually recover their constitution.

4. This process can take place everywhere and under all circumstances. The harder the outer conditions and the sharper the struggle for existence, the more energetically selection works, and therewith the quicker the development of new forms.

4. The organ of new forms can, however, occur only under favorable conditions of existence for the species, and the more favorable these conditions, that is, the less severe the struggle for existence, the more energetically can evolution go on. New forms do not arise under hard external conditions, or, if any do, they go quickly to ground.

5. The chief requisite for evolution is, therefore, the struggle for existence, and the selection which results from it.

5. The struggle for existence, and the selection that goes hand in hand with it, constitute a factor which limits new forms and hinders further variation and is, therefore, in no way favorable to the origin of new forms. It is a factor inimical to evolution.

6. If there were no struggle for existence, no selection, no survival of the strongest, there would be no evolution and no specialisation, for adapted species would have no advantage over unadapted ones, and as a result of crossing with the latter, they would sacrifice

6. If there were no struggle for existence, there would be no killing out of newly arising or already arisen forms. The world of organisms could then grow to a mighty tree, whose branches could all persist in blooming condition, and the most aberrant, now isolated, spe-

their useful characteristics.

7. The so-called advance in nature or the perfecting of organisms, is nothing else than a more complex, more complete adaptation to outer conditions, and it is reached in a purely mechanical way through selection and the accumulation of characteristics useful under the existing outer conditions.

cies would be connected with all others through intermediate forms.

7. The adaptation which comes to exist through the struggle for existence is not at all identical with an advance, for higher, more specialized (vollkommenere) forms are by no means always better adapted to outer conditions than the lower ones. One cannot explain the evolution of organisms in a purely mechanical way. In order to explain the origin of higher forms out of lower it is necessary to admit a special tendency, in organisms, for advance, which is nearly related to, or identical with the tendency to vary, and which compels organisms toward perfectness as far as external conditions allow.

This theory of Korschinsky and de Vries is not based on any belief that sports or large variations are any more numerous, nor of any more worth as the beginnings of new species, than now generally recognized, but it assumes sudden radical changes in the organism which, if not visibly large as regards obvious quantitative conditions, are large, or at least comprehensive as regards qualitative conditions. The mutation or variation assumed by the theory of heterogenesis affects many organs and parts, structurally and physiologically; it produces a radical change throughout the organism. And this change is the result of an influence wholly intrinsic, inherent, and has no reference to external

conditions, except in that the stimulus for it may come partly or chiefly from specially favorable conditions of nutrition. This change is at once definitive and fixed; it is transmitted unimpaired to the offspring of the organism showing the mutation, only the capacity for the production of offspring: i. e., the reproductive fertility, is often weakened (p. 336).

The theory does not call for "sudden and large changes or variations," although it does for "sudden and fixed ones."

De Vries insists that instead of "variations which are changes in a *linear direction*, the transforation to be called mutations constitute divergence *in new directions*. They take place as far as experience goes, without definite direction." And even if transition forms exist between the species produced by mutations, they are no evidence against the mutations "for," says de Vries, "the transitions do not appear before new species, at most only simultaneously with this, and generally only after this is already in existence. The transitions are therefore no intermediates or preparations for the appearance of the new forms. The origin takes place, not through them, but wholly independent of them" (p. 338).

While de Vries admits that recorded mutations are few: "mutations under observation are as yet very rare; enough to indicate the possible and most probable ways but no more"; yet he strongly maintains that there is no scientific proof of the origin of species in any other way than by mutation and that there is such proof of their actual mutational origin. He says: "I intend to give a review of the facts obtained from plants which go to prove the assertion that species and varieties have originated by mutation and are at present not known to originate in another way" (p. 339).

But in any consideration of de Vries' work and theories, one must have clearly in mind the distinctive meaning which de Vries attaches to the word species. However little biologists agree on any absolute definition of species, the term

nevertheless is consistently used to refer to differentiated organic types between any two of which there is considerable obvious describable difference, either qualitative or quantitative. If two types of such obvious difference in one or several characteristics (usually external or at least externally noticeable differences are the ones used) are connected by a series of connecting gradatory forms existing either in the same territory or in other regions, the two forms are not referred to as distinct species but as varieties; at least the form at one end of the series is called a variety from the other end. By de Vries species and varieties are of different stuff. Specific distinctions with him are based on differences in aggregation of the elementary units, the *Einheiten*, that go to compose the specific types.

With de Vries, then, species mean two different things; first, the systematic species, which florists and systematists use, and which should be retained as such, lest a new classification hopelessly confuse students, by the immense additions that would have to be made to our lists, and second, for our purpose we must find through "pedigree culture" any form which "remains constant and distinct from its allies" and this form is then to be considered the elementary species (p. 340).

A statement made by de Vries must be recorded on account of its value from an orthogenetic viewpoint; as he shows that it is already within the seed that the mutations-possibilities must be sought. Here is what he says: "*Obviously the mutations must be decided within the seed.*" The italics are ours.

As Professor Kellogg says, On the whole the theory has been warmly welcomed as the most promising way yet out of the difficulties into which biologists had fallen in their attempts to explain satisfactorily the phenomena of the

origin of species through Darwinian selection. And especially has been welcomed the fruitful idea of unit species characters, and of the indivisibility and the distinctness of such characters, in inheritance. But with all the interest aroused by de Vries' presentation of his theory, and with all the eager scrutiny of species and records of species appearing an output of new evidence amazingly small (when one stops to consider the publicity gained for the theory itself and its obvious need of more confirmatory data of observation and experiment) has resulted. Even though the answer may be that experiment takes time, the lack of new observational evidence of the occurrence of mutations, and of the origin of new species through mutations in nature, is significant. It is my belief that a reaction against the curiously swift and widespread partial to complete acceptance of the mutation theory as the sufficient 'way out' of our troubles to explain the origin of new species will soon occur (p. 348).

Conklin well says, "The mutation theory is a theory of the evolution of organisms through the evolution of their germ cells."

Bateson has suggested that mutations may be Mendelian recessives coming forth, and to understand this we suggest the reading of our chapter on Genetics. Simply stated it means that after breeding, a certain proportion of the offspring will show after the second generation, certain unit characters, let us say, the color of the hair. Three out of four of the offspring will have the color known as "dominant," the other one the "recessive" and if these recessives are bred together the color of the non-dominant will, of course, be predominating.

It is interesting to note the excerpts from the addresses delivered before the American Society of Naturalists at Philadelphia, December 28, 1904, when distinguished men in various fields of biological work spoke in regard to the

mutation theory. Castle said:

On the whole, it appears that the formation of new breeds begins with the discovery of an exceptional individual, or with the production of such an individual by means of cross-breeding. Such exceptional individuals are mutations (p. 362).

Dwight said:

It is to my mind impossible to find any support for a theory of evolution by minute changes from the study of anatomical variations. I should not venture to say, on the other hand, that they give any support to the theory of mutation; but at least they are not in disaccord with it (p. 363).

And Wheeler:

It seemed necessary to discuss ethological characters at some length for the purpose of vindicating their importance. Having attempted this, I may say that these characters seem to me to offer even fewer difficulties than the morphological characters to the acceptance of the mutation theory, for the reason that the ethological and psychological processes are conceived primarily as qualities and not quantities. Thus the psychical elements, i. e., the simple feelings, cravings, and sensations, are disparate qualitative processes which cannot be derived from one another or from some more undifferentiated process. This is still more evident in the case of the complex psychical phenomena. Similarly, instincts, with which ethology is most concerned, when resolved into their simplest components, are seen to consist of discrete reactions which can not be shown to rise from one another. Although, on the other hand, the measurable intensities and durations, of the reactions are analogous to the fluctuating structural variations, it is even more difficult for the psychologist to conceive of a particular feeling, craving or sensation of some other psychic

process, than it is for the morphologist to conceive of the origin of new characters from the fluctuating variations of structure.

Mutation is even more urgently demanded for the explanation of many other instincts, especially those of symbiotic or parasitic species and of species with profound and sudden metamorphosis. In these cases, a particular activity, on which most often depends the life of the individual or of its progeny, has to be performed with a high degree of proficiency at its very phylogenetic inception or it can be of no advantage to the individual or the race. Such cases, with which you are all familiar, have ever been the insurmountable obstacle to the evolution of instincts on the theory of fluctuating variations and natural selection. The theory of organic selection seems to be merely to conceal but not to overcome the difficulties. The mutation theory frankly avoids the difficulties even if it fails to throw any light on the origin of the mutations and bundles this into the germ-plasma. It is of course no objection to the theory that it leaves something under the heavens to be accounted for. This is rather to be regarded as one of its chief virtues. As working naturalists we have reason to be most suspicious of the theories that explain everything (pp. 363-364).

And lastly we have the neo-Vitalists regarding whom Kellogg, who differs radically from them, says:

The position of the new Vitalists is perhaps best to be taken from that of Driesch, an extremely able present-day biologist, whose first belief was in a radical mechanical explanation of all life phenomena, and whose brilliant experimental work has furnished many of the examples referred to in the text-books of the modern study of the mechanics of development. But Driesch's present position is an uncompromising belief in the impossibility of explaining life-forms and life-functions on the basis of ever so complex a combination of purely physico-chemical and mechanical conditions and factors. Put positively, neo-Vitalism de-

mands the assumption of an extra-physico-chemical factor (called "psychoid," according to Driesch's nomenclature), which is an attribute of, or essential kind of potentiality pertaining to, organized living substance, and not found in nor influencing inorganic bodies.

Bütschli has well pointed out that neo-Vitalism is really only a return to the old "vital principle" belief, and that we are now and have been ever since our practical giving up of the vital principle notion, making steady progress in the explanation of life-forms and life-functions on strictly mechanical and physico-chemical grounds. While we have by no means explained all life attributes in this way, Bütschli holds that our progress has been such as to make no demand for the introduction as yet of a new vital principle under a pseudo-scientific guise.

Other neo-Vitalists, one of whom G. Wolff is a type, lay chief stress on the inexplicableness of the *Zweckmässigkeit* in organisms by any of the known biological facts and factors, and see in the determination or very existence of this *Zweckmässigkeit* the chief revelation of a vital factor, wholly distinct from anything found in the inorganic world. Wolff's argument is clever and suggestive, and brings home to one strongly the indissoluble relationship between living matter and its adaptivity. In its fundamental character life is adaptivity; the indispensable relation between living matter and the rest of nature is the pliability, the adaptiveness of the living matter (p. 226).

These are the various theories as Professor Kellogg sees them and it will be agreed by the majority of biologists that he has done his work well and that there is a great breadth of reading and an almost unbelievable familiarity with the many systems or theories propounded to account for evolution. This work appeared in 1907. We have before us the August number (1916) of *The American Naturalist*, in which Dr. Chas. B. Davenport, the geneticist, gives what he calls "The Form of Evolutionary Theory That

Modern Genetical Research Seems to Favor." In which he shows quite conclusively that from experimental researches the "Internal changes are chiefly *independent of external conditions*," and that this theory has the support of workers in the many fields that can and do throw light upon the matter.

Wasmann has well summed up the whole matter when he says that in discussing evolution it is necessary to

distinguish (1) between the theory of evolution as a scientific hypothesis and as a philosophic speculation; (2) between the theory of evolution as based on theistic principles or as based on a materialistic and atheistic foundation; (3) between the theory of evolution and Darwinism; (4) between the theory of evolution as applied to the vegetable and animal kingdoms and applied to man.

As a scientific hypothesis, the theory of evolution seeks to determine the historical succession of the various species of plants and animals on our earth; and with the aid of paleontology and other sciences such as comparative morphology, embryology, and bionomy, to show how in the course of the different geological epochs they gradually evolve from their beginnings by purely natural causes of specific development. The theory of evolution, then, as a scientific hypothesis, does not consider the present species of plants and animals as forms directly created by God, but as the final result of an evolution from other species existing in former geological periods. Hence, it is called "the theory of evolution," or "the theory of descent," since it implies the descent of the present from extinct species. This theory is opposed to the theory of constancy, which assumes the immutability of organic species. The scientific theory therefore does not concern itself with the origin of life. It merely inquires into the genetic relations of systematic species, genera, and families and endeavors to arrange them according to natural series of descent (genetic trees).

How far is the theory of evolution based on observed facts? It is understood to be still only an hypothesis. The formation of new species is directly observed in but a few cases, and only with reference to such forms as are closely related to each other. . . . There is, in fact, no evidence whatever for the common genetic descent of all plant and animal forms from a single primitive organism. Hence, the greater number of botanists and zoologists regard a polygenetic (polyphyletic) evolution as much more acceptable than a monogenetic (monophyletic). At present, however, it is impossible to decide how many independent genetic series must be assumed in the animal and vegetable kingdoms. This is the gist of the theory of evolution as a scientific hypothesis.

As to the theory of evolution considered philosophically:

The history of the plant and animal kingdoms upon our globe is but a small part of the history of the entire earth; similarly, the geological development of our earth constitutes but a small part of the history of the solar system and of the universe. The theory of evolution as a philosophical conception considers the entire history of the cosmos as an harmonious development, brought about by natural laws. This conception is in agreement with the Christian view of the universe. God is the creator of heaven and earth. If God produced the universe by a single creative act of His will, then its natural development by laws implanted in it by the Creator is to the greater glory of His Divine power and wisdom. St. Thomas says: "The potency of a cause is the greater, the more remote the effects to which it extends" (Summa c. Gent. III, LXXVII); and Suarez: "God does not interfere directly with the natural order, where secondary causes suffice to produce the intended effect." (De opera sex sierum, II, c.x.n. 13.) In the light of this principle of the Christian interpretation of nature, the history of the animal and vegetable kingdoms on our planet is, as it were, a versicle in a volume of a million pages in which the natural development of the cosmos is

described, and upon whose title page is written: "In the beginning God created heaven and earth." [8]

We have already shown the value of a scientific hypothesis, in a previous chapter, and have there called attention to the fact that such hypothesis is essential in all experimental work, and that *we are justified in accepting it as a working hypothesis regardless of its being true or not, if our experiments work out as though it were true.*

We have further shown that it is then necessary philosophically, that is, from the rules of logic, to establish (after we have found our first principles) the hypothesis on solid grounds before it can be accepted as truth.

This is what Wasmann means in the citation given above in his first division. Likewise, we have taken his second point and shown that it is necessary to start somewhere and with a definite viewpoint or a "creed," as Dr. Bourne puts it, and this we have stated in his own words. That is, there are really two schools of thought involved, the one like Professor Kellogg, who insists on starting with a causo-mechanical viewpoint, or creed, and throwing out of court all things that do not fit in therewith, the other school insisting on an original creative act, and as the causo-mechanists have not yet been able to formulate a single valid reason for actual BEGINNINGS of anything, the latter really have the best of the argument.

The difference between Darwinism and Evolution we have made clear in this very chapter, for, after all, that is practically what this whole chapter is written for.

And lastly, the difference between the animal world at large and man is really not a difference of the physical at all, except to a very small extent. The argument should,

[8] Article, "Evolution" Vol. V. Page 654, Catholic Encyclopedia.

and *must, be carried into the thought world—into the realm of philosophy and psychology,* for it is in the field of thought and of spirituality that the difference is found, so that men, such as Professor Wm. Wundt, the greatest living experimental psychologist; Professor Wheeler and Professor Wasmann, world-renowned authorities on the supposedly most intelligent of animals, the Ant, have all come to the conclusion that there is an immeasurable difference between the "reasons" of animals for performing the acts they do, and the reasons men perform similar ones.

Here is the battleground of the future, for already much of our interpreting of the physical facts has fallen to the ground as worthless, as witness, for example, many of the supposedly vestigial or rudimentary organs, among which the ductless glands were originally considered, but which we now know have a most valuable use in forming minute particles which in turn permit other glands to function properly.

Professor Haeckel's theory that man passes through the same stage as did the race, that is, first becomes a fish, then going on through other forms, until he shows in his embryonic development, every form through which his ancestors have passed, is a theory which Professor Kellogg well says is now only a skeleton on which to hang exceptions, and as has also been said by another Biologist, that there is a big difference between saying that because a human being passes through a similar stage as does the fish, that therefore the human must have been a fish once upon a time, *when all that should be said is that the human and the fish pass through the same stage.*

No fossil remains have disclosed a missing link of any description. A jaw has been found, part of a skull, or a tooth, but to build up a whole theory on a single part of

the body is extremely hazardous.

And the argument that because men and animals are so similarly built physically, the former must therefore have sprung from the latter has always seemed to the writer most specious reasoning, for it assumes that because the Creator did not build a totally different form in each case and show how many things He *could* make, therefore He didn't have anything to do with any of the things He did make. Continuing with the article quoted above by Professor Wasmann:

That God should have made us of natural, evolutionary, original causes in the production of man's body, is *per se* not improbable and was propounded by St. Augustine.[4]

The actual proofs of the descent of man's body from animals is, however, inadequate, especially in respect to paleontology. And the human soul could not have been derived from that of the brute, since it is of a spiritual nature; for which reason we must refer its origin to a creative act on the part of God.[5]

In reading such a volume, then, as Professor Kellogg's we are confronted by the indisputable fact that among the men who have the facts before them there is a most hopeless mass of irreconcilable theories. How many hold to either side or to any particular theory no one knows. There is Professor Fleishmann, of the University of Erlangen, a most noted Biologist, who absolutely denies that any Evolution of any kind has been demonstrated.[6] It is true that he is the only one of the recognized Biologists who take this extreme view, but it throws a light on the so-called "evidence" at least that is furnished for proof. Then there

[4] See Article "Augustinism in History," under V. Saint Augustine of Hippo, Catholic Encyclopedia.
[5] Article, "Evolution," Vol. V. Page 654-655, Catholic Encyclopedia.
[6] See Page 8, Darwinism To-day.

are the ever-growing numbers of workers in biological fields who have accepted Orthogenesis, that is, an inner driving force of some nature, though as shown, one school explains this is a physico-chemical manner, the other in a vitalistic. But all admit that nothing has as yet been explained as to *origins of organic matter;* a growing number are constantly coming to Nägeli's and Driesch's viewpoint of Vitalism, recognizing the immeasurable distance between the living and the non-living and between the highest form of animal and the lowest of human-kind.

But it must ever be remembered that new names are given to old doctrines, and often a description answers where an explanation should be found, so, that as Sir Bertram Windle has well said, it is exactly this orthogenetic and vitalistic doctrine that the most intense defender of the "soul" theory ever contended for, yet many, if not most of these men who actually hold these self-same doctrines, would rather perish than give this "something," which is the inner driving force, so antiquated a name as "the soul." Here we have the interesting spectacle of a great number of scientists being perfectly agreed on a subject but most insistently fighting over its name.

So that we may say with the last writer quoted above, that as long as men who have all the known facts before them cannot come to a decision, the average man would do well to ponder long before he jumps at conclusions too abruptly.

CHAPTER VIII

VITALISM

ROUGHLY speaking, we may divide the curriculum of any school attempting to embrace universal knowledge, into three great divisions: (1) the study of non-living matter, (2) the study of living matter and (3) the study of the thought-world.

Everything we know—everything that we can possibly study or think about—must come under one of these great classifications.

We have shown in our chapter on Metaphysics and Epistemology that nothing can be known at all, unless we begin with self-evident and unprovable First Principles, and in our chapter on Logic we have shown that from these principles it is necessary to build up, step by step, the superstructure of theories or truths we are seeking to demonstrate.

First, we wish to call attention to the Non-living part of our universe, or as it is usually termed in technical language, the Inorganic. Such studies as Physics, simple Chemistry, Geology, and Astronomy come under this Inorganic heading. "Physics" attempts to find the physical laws of the universe by which men may be able to tell in advance what effect a given thing will have when set in motion, for in the last analysis, Physics deals with Motion, and Motion only, while "Chemistry" attempts to find the laws by which it may tell what given combinations of irreducible substances, called elements, will produce a given result, there being two general

ways of going about it; one, takes a compound apart so as to find what simpler compounds or elements entered into the matter analysed, and the other experiments with various simpler compounds to ascertain the result obtained by their mixing. This first method is known as "analytic," while the latter is called "synthetic." "Geology" in its broadest sense means the application of the laws found in Physics and Chemistry to our own earth, while Astronomy applies the same laws to other worlds than ours.

Under the study of the Living, we have one science that embraces everything: namely, Biology, but this is divided again into the Plant world and the Animal world. And Man considering himself as the highest form of living things naturally attempts to apply all laws that are found in any of the other fields of study to himself. This is what, after all, makes other branches of learning interesting. In and of itself, if no application whatever *could be made to man* from the findings, it is doubtful whether many would make the attempt of ascertaining these now-so-interesting laws. And decidedly the most interesting and most valuable discussion in all scientific fields centers around the application of the physical and chemical laws to actual LIFE. Can Life be explained on the basis of the laws of Motion and the laws of Chemistry? In other words, what evidence is there that would lead us to answer this question in the affirmative or the negative? Is there any need of postulating anything beside these laws? And if so, what can be postulated, and is there any evidence for the postulate?

It is true that it is very difficult for most men and women to look at this question fairly on account of their training and their prepossessions, but, if one is to pass judgment well and worthily on any subject, it is more than necessary to throw out all manner of emotional desire and face the

facts as they are definitely demonstrated in the laboratory and the logical conclusions that must be based on such findings.

First, then, we may say that those who hold that the physical and chemical laws can alone explain living matter, are called Causo-mechanists, while those who oppose this view we shall call Vitalists.

We have explained what the Causo-mechanists are and now shall attempt to give definition to what Vitalists hold, but it must not be forgotten that the Vitalists, just as well as the Causo-mechanists accept as freely and as fully, all the physical and chemical laws that have been established. The Vitalist insists, just as definitely as does the Causo-mechanist that these same physical and chemical laws are found to be working in all living things. He even accepts the machine theory of life which the Causo-mechanists constantly use in their explanations, but he does not stop there. He insists on driving the matter still further home. And in doing this, the great outstanding problem is that known as Teleology, which in turn means that *there is a definite end toward which all living matter tends* and which it usually succeeds in attaining, at least partially. In other words, the problem hinges on whether or not there is "purposiveness" in life, and here again a further problem arises as to what is meant by this word "purposiveness." It is quite probable that many fighting each other have come to grief in regard not only to the meaning that is to be attached to the word, but also how it is to be applied to life. That there is some purposiveness in life no one denies; for example, that the eye in each individual develops for the purpose of the use to which it is put, is self-evident; that food is eaten for the purpose of nourishment and that it fulfills its purpose in health is likewise accepted, but this kind of purposiveness,

while interesting as a problem in itself is not the problem with which and on which our interest centers in discussing whether the physical and chemical laws are sufficient to explain life. What we are after is this: to show the distinction between two different kinds of purposiveness. The one materialists accept is that the body of a living thing is a machine-like structure and that just as any machine made by man, is made for a definite purpose, and, when properly managed and run, will turn out the kind of work for which it was intended, so does the living machine, but the other, to which Vitalists call attention, is not this kind of teleology or purposiveness, but, just as in the analogous case of the man-made machine, so in the living machine, the question propounds itself, *what is the reason that the machine has become a machine?* And with this important question arises another one, namely, why is it that there is no machine that has ever been made that will turn food into nutrition for itself, that will re-grow a lost part, that will produce other machines like itself, and most interesting of all, that will, if three-fourths of it be cut away, no matter what parts of it these may be, produce with perfect precision, though on a smaller scale, the whole machine; and, lastly, there is no machine that has yet been able to adjust itself to a different environment than the one in which it has been placed; e.g., it will always and invariably, so long as it is in good working order, do only the same thing under the same conditions? Why also is it that a machine will not grow larger, no matter what nutritive things may be given it, but works, rather, on exactly the reverse methods, by commencing to wear away from the very moment it is first put into use, whereas the living body increases through its own inherent ways of building—of growing from the most minute germ-plasm to a full and complete living adult,

reproducing, and then beginning its downward path, that leads to dissolution?

We see, then, two types of teleology must be kept in mind if we are to make any progress in our discussion. First, the machine type of teleology and secondly, the reproductive, growth, and regenerative as well as adaptive type. In other words, we may say, the first attempts to explain why the machine turns out the work it does after the machine is made, the latter, how the machine came to be made and what the purpose was in making it. Or as Professor Hans Driesch, one of the ablest Biologists of the present day, has put it:

> The main question of Vitalism is not whether the processes of life can properly be called purposive; it is rather the question if the purposiveness in those processes is the result of a special constellation of factors known already to the sciences of the inorganic, or if it is the result of an autonomy peculiar to the processes themselves.[1]

Vitalism is concerned with the Organic world, because it is concerned *with processes* that are especially adapted toward certain ends, or processes that at least have a position among objects in a system that may be working toward a certain end, and where as far as we can see, the driving force that keeps the adaptiveness working is contained within the living thing itself as contradistinguished from the inorganic where the only force that causes any change of any kind whatsoever is from the outside. And then we have the further important thing to consider, that always the same process is performed in all similar organisms under the same conditions, when no injury has taken place to the

[1] The History and Theory of Vitalism, by Hans Driesch (Macmillan). All explanations and quotations in this chapter up to Note 4, are from this volume.

organism.

And Professor Driesch also makes a very excellent distinction in his brilliant discussion of the subject by calling attention to the fact that we are dealing with processes and processes only. That a machine as a thing is not a process. The machine made by human hands is made *for processes* and every single process in a machine is purposive.

It is the result of purposive action, of human action, but it is the fact that it is made for processes that distinguishes it from other human artefacts, from works of art for instance.

There are, then, inorganic things, namely, those made by men, which show us processes deserving the predicate purposive. It is clear that here the purposiveness of each single process rests on the specific order of the specific parts of the machine, and is determined by this order. In other words, each single effect in a machine is only purposive in so far as it is part of a higher specific whole; and this is in virtue of the constitution or structure of that whole.

Our reasoning has now brought us to a point at which the problem which we have described as the fundamental problem of biology presents itself for consideration. We are confronted by the all important question: are these processes in the organism, which we have described as purposive, perhaps only purposive in virtue of a given structure or tectonic, of a "machine" in the widest sense, on the basis of which they play their part, being purposive therefore only in the sense in which processes in a machine are purposive; or is there another special kind of teleology in the realm of organic life (p. 4)?

The usual use of the word "Teleology" is only descriptive. It does not really mean anything explanatory, biologically considered, as it is used; it

leaves the most important point still open, for life in particular this question: are the processes of life to be judged teleological only in virtue of their given order, only because a given mechanical form lies beneath them, while every single one is really a pure physical or chemical process—or are the processes of life purposive because of an unanalysable autonomy?

And this is called the machine type or "static Teleology" while the deeper processes which lead to the making of the machine, Professor Driesch calls the "dynamic Teleology." He insists that it is the "static" type that leads to the mechanistic theory of the organism: that is,

the process of life and its order is only a special case of those laws which are valid elsewhere and of the general order of the world. The constellation of all the single cosmic elements just happens to be of such nature that we also get amongst them those processes which are grouped together as "life." According to this view life is only distinctive as a combination and not because of its own laws. The question whence comes the given order with which static teleology operates is insoluble; and it is precisely owing to this circumstance that the life-machine does appear to be something different from technical machines whose origin we know, even if the kind of purposiveness is the same in both cases.

Dynamic teleology leads us to what is generally called Vitalism; it leads us to the recognition of the "Autonomy of vital processes."

As we have shown in our chapter on Logic, it is from this subject that we obtain the *validity for all our reasoning*, and if the laws of Logic fall, we can know nothing validly, for it is, and can only be through Logic that we gather knowledge and arrange it in an orderly manner so it will possess a meaning.

First, then, we wish to summarily put together the main points so that he who has had no logical training, may yet see why we lay such stress on the subject.

It will readily be admitted that in the study of living things there are the two great divisions—the physical and the psychic—the difference between contending parties being entirely as to the connection or difference between these worlds, never that we know them as separate entities *now*.

So then, we know, that all proof,—all ability of every kind whatever, to prove anything—must rest with our thoughts, for one who can not think, can not explain anything, and one who can not think can have nothing explained to him. We must have thought; but to think, means to have something to think about. As soon as we think of something we know that the mere fact that we ourselves are thinking and that we are thinking about something, proves to us there are two totally different existences in the world. One is the thinker, the other the thing thought about. But we also know from this that when we are describing the thing thought about, let us say an orange, we pull it to pieces mentally, we say, we see "yellow," we see "roundness," etc. We are only taking parts of it at a time in our thought, but still the orange being the sum total of all these attributes we are describing, we get a notion of a WHOLE and its Parts. Now if what we have in our mind is an image and if this is an exact representation of what is actually before us in the physical world, we think of this agreement as TRUTH. And *the object itself*, of which we have the image is *what we mean when we speak of the "physical" or of "Nature."*

Further, in our analysis of thought we find that we have something in mind that is *now* before us, or we may think of something that has *just now happened*. But we may also think of things that *have happened in the past*, and

some even that *may occur in the future.* In other words, we know *what is present as being Now,* and that which has occurred in the past as *before Now,* or even *"earlier than" some thing else.* This gives us what we call a *relationship.* But during this whole process of Now, and what happened in the past and what may happen in the future we still always use the pronoun *"I"* in speaking. *"I"* am seeing this; *"I" saw* this yesterday; *"I" shall see* this to-morrow. There is then the underlying knowledge that *"I" exist as an individual,* and notwithstanding the past or the future, *it is always "I" that am the same;* it is my thought that is changing. *This idea of change is* often *called "Becoming."*

And if we are positive that what we have thought in the past has resulted in our thinking what we do at present, that is, if we know that we could not feel and think as we do now if we had never had the experience we have had in the past, we have the theory of "Causality" in its simplest definition. All we mean by this is that every thought we have has come to us because we have had other thoughts before that have caused the result.

It is important to remember that if these things are not true then there is no truth, for it is the only way we have of arriving at a truth, and if by truth we mean an agreement between what actually exists in the physical world and the impress of it in its fullest signification in the mind, we must always seek this agreement between the physical and the mental to arrive at the truth. That is we can find this principle of causality in Nature very readily, for, in accordance with the laws of mind we have just drawn, everything that we have in the physical world, or what we call Nature, is the direct result of forces of some kind that have gone on in the past which have caused the present things to be what they are.

So far, we shall in all probability have no objections offered. All this is self-evident, but essential, in order that the meaning of our words be understood. And as it was the "I" that endured in the thought world, so "Substance" is what we say "endures" in the physical. Now, Nature or the physical world occupies space. It is impossible for us to imagine anything in the physical world about us that does not occupy some space, BUT, about earlier changes, we cannot say definitely that the changes themselves, which are the cause of our present world-forms, necessarily occupied space. They may have done so, but it is neither necessary to assume that, nor could it probably be proven one way or the other.

Let us take a physical law to which we have never been able to find any exceptions; namely that "Nothing can rise higher than its source" without an outside agency adding additional power of some kind. Or as Professor Driesch puts it, "that which forms the reason" for anything "must always be richer in content; i.e., richer in attributes than the other which is its consequence." This richness or manifoldness means that there must be a greater

number of different irreducible (elementary) characters than in the result that the cause produces. We have then the law, "The degree of manifoldness of a natural system can never increase of itself, i. e., without a cause as its quasi-sufficient reason" (pp. 196-197).

This merely means that if any given cause produces a result that is more complex than itself, that complexity or additional matter that caused it must have come from the outside and not from itself.

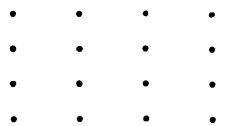
In the non-living world all growth is by accretion—by adding to the outside of the object; in the living, just the

reverse method takes place, all living things growing from the inside outward.

It is of course, easily conceivable that between two given moments "the number of elementary material constituents (atoms) of a system might increase without there having been a passage of atoms into the system from 'outside' in the spatial sense," and if this be true, either our thought means nothing, or we must accept "*thing-creating agents*" which have made these atoms.

Then another possibility presents itself; namely, that a thing which has not been changing, may at a given moment begin to change, and yet we can find no moving cause. "*Change-creating agents* must have been at work in such a case." But we may admit that we have not found these two types actually in the physical world, though they *may be* there, for it does not follow that what has not yet been found, is non-existent—and if they should be there, they may some day actually be brought to light.

Then there is still another type of change which may take place. Let us suppose we have four rows of four dots each, such as in the drawing, with different relations between them.

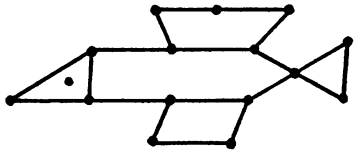


Now it is very easily understood that there may be a change within this that does not really affect space, that is, there may be a change in the relationship of the different dots. Let us say that these may continue to remain in the position and relationship they are in, up to a certain moment, and then, no matter under what conditions we find

them, a change in the number of different kinds of relations may take place. In such a case, there would be immaterial or non-spatial agents at work, or again there is no foundation for the becoming or change at all, on a logical basis. In other words, there has been a sufficient reason in space for "becoming" in general, i.e., there has been a supply of spatial energy for what has happened; but *it is with regard to the peculiarities of becoming that there is a lack of sufficient reason in spatial change.* "There must have been non-spatial agents of a controlling type, so to speak" (p. 200).

The most important form of this type of change would be where a distribution in one system that is really a *sum*, is transformed into a distribution that would be in some sense a *unity* or *totality*, without any spatial mechanical predetermination of this totality.

Using this figure of Professor Dreisch's of sixteen points, an arrangement that may be defined by very few terms, because it is of a very low degree of manifoldness, may be transformed into an arrangement such as this:



without spatial preformation. There are sixteen things in each case, but the first arrangements of these things is clearly a sum, whereas the second resembles—a "fish."

We shall call this type of becoming, *unifying* or *individualising* causality.

If a system passes through several phases of becoming

in succession, all controlled by unifying causality, we may speak of the *evolution* of the system,

and every single unity of becoming that leads to unity as the *final end* may be called purposive or teleological.

And we wish to impress upon the reader that it is this "unifying causality" that "is the prototype of biological, i.e., vitalistic becoming" (p. 201).

Vitalism proper, then means that *there is an autonomy of the processes of Life.*

It is not necessary to assume, nor is it assumed, that this autonomy creates any matter or energy or any of the prerequisites of change as such, just because we say there is a unifying agency at work. All we need say is that this autonomy or unifying causality, for that is all it is, is regulative, or we might say that it controls the particular way in which the energy manifests itself.

There is here no breaking of the law of the conservation of Energy, nor of the principle that all change is due to a difference in intensity of energy, such as heat, cold, etc.

Now, all that is claimed for this autonomous principle which is called the "entelechy" is that, due to it, there may be a suspension of any particular happening as is possible on the basis of pre-existing differences of intensity and as would occur without such suspension. Suspending possible change and relaxing suspension would then be the two modes of "action" of the bearer of individualizing causality and this is what is called "entelechy."

In regard to the figure, the points stand for sixteen systems equal one to another and each endowed with endless "possibilities" (in the form of given differences of energetic intensities), we can understand how this homogeneous distribution of possibilities may be transformed into a hetero-

geneous distribution of realities, as in figure 2. In order that this may happen, it is only necessary that "entelechy," which is supposed to have suspended all possibilities so far, relaxes its suspension for each system in a different way. This avoids the argument advanced against Vitalism that this life-principle should be omnipotent. It is only regulative, and as such can create nothing. It merely controls that which already exists. And it is important that we remember that "entelechy" or "any other individualizing agent, if such there be, is itself neither an 'energy' nor a 'material substance' of any special kind, such an assumption would lead to absurdities. Entelechy is an agent *sui generis*, non-material and non-spatial, but acting 'into' space, so to speak; an agent, however, that belongs to nature in the purely logical sense in which we use the word" (p. 204).

And here we wish to impress the point that this has nothing whatever to do with the *origin* of life. It is simply another way of saying what Dr. Ward says in the article on Psychology in the eleventh edition of the *Encyclopedia Britannica*, that "Life must be regarded as either inherent in matter, or as the result simply of a particular material configuration, or as physically inexplicable. But, for the present at all events, it cannot be explained physically; nor are we even within measurable distance of such an explanation: so much is beyond cavil" (p. 601, vol. 22).

From the purely materialistic viewpoint, only that is permitted to be discussed which can find its way for demonstration purposes in the laboratory. Science consists in describing phenomena; it cannot, and *never has explained anything*. It cannot answer a WHY, it can only tell us HOW some results can be obtained by doing certain things, but WHY these particular results are obtained when this particular thing is done remains unanswered. And as Science

has not been able to explain Life, many biologists, prominent among whom stands Professor Hans Driesch, who like many others started with intense materialistic and causo-mechanistic ideas, have reversed their position and come to the conclusion that no progress toward truth can be made unless some "unifying principle" be accepted. This is a necessary hypothesis, for without it we cannot explain how the little fertilized germ-cell, by constant dividing develops always and ever, one part into the digestive tract, another into the heart, another into a particular gland, etc., until the whole adult form of the individual is reached. To apply the machine theory here, would be doing so with a vengeance, for first, we have a complete little machine—the fertilized cell—this divides into many parts, each becoming exactly what every similar part in every similar cell becomes, and goes right on developing into its adult form, and when each part working along entirely separate paths has finished its growth, we find each organ fitting in most harmoniously into the whole completed and complex adult form.

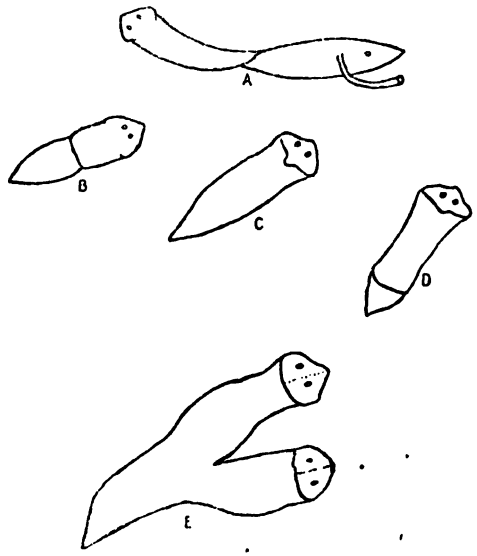
So the "entelechy" is not an explanation of the *origin* of Life; it is an explanation of how each part comes to "unify," to make a complete organism, and it for this reason and this reason only that we *have to* postulate a *unifying causality.*

And as we have shown in another chapter we must have an hypothesis on which to work. There has been no other theory that has proven at all satisfactory, so, as this theory does "explain" and as all of our experiments do work out as though it were true, we are justified in making use of it.

So much for our hypothesis. Now let us review some of the facts of both observation and experiment as they actually exist in Nature.

In embryology we find many of our most interesting examples. We may take and deprive a very tiny organism

of most of itself, not exceeding three-fourths, and each part will develop into a *complete* whole, though in miniature. This means that every quarter of the organism has the possibility of becoming a complete adult, yet under normal conditions it only becomes *one instead of four individuals*. On the sea-urchin, on which the experiment was performed, the growth



Planaria. A. Planaria entire. B. Head growing new body after cutting off body proper. C. Body growing new head. D. Central part of body growing new head and tail. E. After splitting head and part of body, each half has regrown. (A. after Shipley and MacBride.)

of the organism was permitted to go on some distance before the separation into parts was made, and still the above results were obtained.

By "regeneration" or "restitution" we mean the power of restoring some part of itself which has become lost, after the animal has more or less completed its growth, and as an example of "unifying causality" at work, we may mention the

common Crayfish, which will grow another eye when the original one has been removed, sometimes growing several, and then developing a sort of "feeler" in its place, should it be destroyed again. The little flat-worm, called planaria, will, if its head be removed, grow a new head on the body and a new body on the head.

The branchial apparatus (gills) of the Ascidian Clavellina is able to arrange itself into a complete little organism without any formation of new cells, and any part of this apparatus will do likewise, "cut it how you will."

From these examples alone, it is plain what is meant by the teleology of which we are speaking, i. e., that there is an inner cause that forces some part, never under ordinary circumstances growing into more than one particular thing, into whatever is needed for the protection of the individual who has lost a part of himself, that is, that these things are adapted to an end.

As Professor Driesch says, it was legitimate, before we had any of these experiments, to assume with Weismann that there was a machine inside of the harmonious system that caused all this. But experiments have shown "that any part of the system however large and wherever taken, may be cut away from it without disturbing proportionate development. This proves that a 'machine' cannot be the basis" of this harmonious arrangement of which we have spoken, for every part seems to have equal possibilities with every other part. In other words, were it a "machine" it would have to possess a specific arrangement of physico-chemical things and agents, and it could not "remain itself, if you take from it whatever you please, and the organism, or better, the non-developed harmonious system *does remain* 'itself,' with regard to" the form-producing faculties, "after any operation whatever."

This "harmonious system cannot" then "be a machine," but is in fact "a something that is governed by this" *unifying causality*, and this is what "entelechy" as, a non-mechanical agent does.

The best argument for Vitalism, is of course, the one we have given of the harmonious arrangement of separate parts, growing from the same cell, and always making up any lost part, so as to insist, as it were, on keeping the completeness with which it was instinctively endowed.

And one of the most interesting points established comes from the study of the ovary. This organ has come from a single cell and this cell has divided and re-divided "innumerable times" until finally we have the many eggs we find therein. "How could a machine *be divided innumerable times, and yet remain what it was?* No machine therefore can be the test of embryology."

For those who lay greatest stress on the mental side, one might mention that the phonograph also reacts to a given stimuli, but only specifically gives forth what has been given it, while in the thought-world, man, though acting also on what has been given him, never reacts exactly alike twice during an entire lifetime. Then there are also the more scientific but also more difficult to be understood "indicia" such as the forming of anti-bodies, etc., but these require considerable scientific knowledge before they can be explained in understandable language.

Summing up Professor Driesch's work along the line under discussion, we may say, "A sum (of possibilities of happening) is transformed into a unity (of real results of happening) without any spatial or material preformation of unity," and this means in ordinary language that the CAUSE of living things growing as they do and becoming what they become, is non-material—that is, does not take up any

space.

Up to here we have been discussing *individual unity*. But there is also a *larger unity*. We must conceive of the entire universe as one complete whole, *logically*. "*Nature is to be conceived as the one order of natural objects;* only if conceived of in this way, can nature be said to be "understood"; for to understand is to conceive as an order." But, this destroys all difference between mechanism and Vitalism, "for it *abolishes mechanism.*" For, surely there can be no "singularity" if everything is one order in nature. It also destroys the concept of the *law of nature.*

All so-called "laws," i. e., all connections of natural principles with regard to being or becoming which are realized in so many "cases" appear, at any rate, as *nothing but features of the behaviour* of that agent which orders "the nature," as features of the behaviour of the *natura naturans.* And these features have no guarantee in themselves of being immutable, as *certainly as nature is a something in evolution.* All natural becoming is like one great embryology; but in biological embryology we know that the "law" of mere cleavage, for instance, holds good for, say, ten cell-divisions and is then followed by the "law" of organ formation.

Every singularity of being and becoming has its own particular place in the order of nature—so runs our postulate in another form.

Now, this does not entail so great a disadvantage to science as would be supposed, for in banishing the conception of "law" it also banishes the worst of scientific enemies, namely *chance or contingency* [2] which Professor Driesch says is the "greatest enemy of thought," for there "*is no contingency where there is order.*"

[2] Professor Driesch uses "chance" and "contingency" as synonymous terms.

We cannot, of course, solve in a final way whether there is complete unity in Nature or not, but from what we do know we can always reason in this way:

Certainly, *what we know* and are even *able to know* about nature does not form one order if taken altogether; there is chance, contingency, non-teleology in what we know. But this is our fault and not the fault of nature. For we have imagined we had the whole of nature where we had only a part; and only that part which is such as *to be accessible to our form of apprehending reality.* We can only receive the one part of reality which appears to us under the signs of spatiality. But only what we call inorganic becoming is completely accessible to us in the form of spatial signs; even in individual organic becoming as studied in biology, is marked to us only by some spatial results but not as becoming; for it is not spatial, i. e., in space, *as* becoming. And who can say how many kinds of being or becoming there may be in reality which are absolutely inaccessible to us, because they are not marked by spatial signs at all? And might it not be that nature would appear to us as the one order we are in search for, if only we knew all those parts of it which, by our mental organisation, we are absolutely incapable of knowing?

But Nature shows that there is some chance, and yet we can get nothing out of either Nature or Thinking unless we have recourse to the dictum that there is a *monism of order*, though there may be some chance in Nature. And the only way we can accept this which must be accepted if we wish to retain any validity to thinking at all, is, by accepting this principle, that *there may be certain areas of reality which have no spatial signs*, as above explained, for without this, not "even the biological problem" can be solved satisfactorily.

So much, for the very complex but highly interesting and valuable contribution to Vitalistic literature made by Pro-

fessor Driesch, whose classic experiments have found their way into most of our standard text-books, and whose ability is not limited to but one side of the question, for he is not only a Biologist of world-recognition but also a philosopher of note, being, therefore, able to speak from a more perfect understanding and a greater breadth of view than are most writers on either side of these two great subjects.

It is interesting to note, that if the causo-mechanical viewpoint, is correct there is an end to all our sciences except Physics and Chemistry, for, if everything can be resolved into a few chemical elements, and, through Physics we may find the laws by which these various compounds then work, there is not only no further need of any other science, but all things have already been explained, which, however, we know is not the case.

Professor Wilson, probably the greatest authority on "The Cell" tells us "the study of the cell has on the whole seemed to widen rather than narrow the enormous gap that separates even the lowest forms of life from the inorganic world." [8]

Von Bunge, the celebrated German organic chemist, insisted that "the mechanical theories of the present are urging us surely onwards to the vitalistic theory of the future."

And we are reminded of Professor Kellogg's remarks in his *Darwinism To-day*, that *the workers in different biological fields* are inclined to *accept different evolutionary theories*, when we note that it is in Germany and in America the thinkers and workers are doing most of the writing on Vitalism, in some form or another, while practically none of it comes from England. This may be due, as Sir Bertram

[8] The Cell in Development and Inheritance, by Edmund B. Wilson, Ph.D., Professor of Zoology, Columbia University. (Macmillan.)

Windle [4] thinks, "to the fact that the Germans and Americans are doing more research work along the study of the individual, while the English have, due to the stimulus of Darwin, been working along racial lines."

The puzzling thing to many if not most students, is found in the many different names writers use for practically the same thing, for example: Driesch uses "entelechy" which, of course, means "a vital principle"; Williams, however, calls it "genetic energy," Henslow, "the property of self-adaptation," Cope "growth" or "bathmic force," Eimer "direction" and Professor B. Moore "biotic energy," but if one will weigh and compare the definitions given to these names by their respective god-fathers, it will not be very difficult to discover the same things traveling under many aliases.

And as we have given the more difficult theories of Professor Driesch, in as non-technical language as possible, we shall here attempt to give in the simplest possible form, the very interesting details of experimental and observational FACTS from which many of the foregoing and all of the concluding ideas of have been drawn.

Frog's and sea-urchin's eggs *always* behave in a definite manner. We know exactly *how* they will hatch, as well as *when*, and it is easy to give a very excellent account of their life-histories. After the fertilised egg commences to divide, it forms a sphere, consisting of a single layer or sheet of cells. Suppose we place the egg between two pieces of glass so as to squeeze it considerably. Quite naturally, the sphere that develops becomes flattened. This cannot be continued too long or the animal would die for sheer lack of space, but when it is released, after this abnormal arrangement,

[4] What is Life? a study of Vitalism and Neo-vitalism, by Sir Bertram Windle, M.A., M.D., Sc.D., LL.D., F.R.S., F.S.A., President of Queen's College, Cork. (Herder.) All quotations from here on are from this volume.

the development goes on exactly as though nothing out of the ordinary had occurred, and we get a larva of frog or sea-urchin, and finally a fully and completely perfect animal.

That is, a frog or sea-urchin has been developed by means of a series of events which one may safely say had never occurred before, a tolerably clear proof that there is within the egg a power which is able to steer it even through seas before unsailed by any egg (p. 66).

Professor Wilson performed an experiment on the eggs of nereis and annelid.

It is a little difficult to describe this experiment without becoming highly technical, so that those who are familiar with the real facts of the case must deal leniently with the writer if he endeavors to make the circumstances clear by simplifying things to the utmost extent. In the normal development of nereis, then, it is known that certain cells will develop into certain parts of the later organism and others into different and distinct parts.

Now, if the egg be allowed to develop under pressure as in the experiments above detailed, the lines of division are vertical in all cases, so that the segmented egg finally forms a plate, a flat plate of eight cells. Now if these cells, thus formed into a plate, are released from the pressure under which they have been developing they at once again divide in an approximately horizontal plane, so that sixteen cells now make up the congeries. The subsequent course of the development of these shows that some of the cells with, of course, their included nuclei, which would under normal circumstances have been worked up into one part of the body, are, under the altered conditions, actually converted into another. The significance of this experiment will be obvious to any one who considers it, but that significance will be increased when it is remembered that the results negative certain views that were held as to the specific character of the nuclei. It was held by some that the nucleus of each cell was of a specific character and could produce a cell

of one type and of one type only. Even if this were the case it would not have helped us very far along the road towards an explanation of the powers of the cell, for we would still be ignorant of how the nucleus succeeded in so modifying the cell as to make it lead to the development of a liver or some other part of the body. But this experiment, and many others of a similar kind might be cited, seems to show that the nuclei of the various cells during development, at any rate, have no specific character, but are capable, to put the matter colloquially, of turning their hands to any job in the gradually rising edifice of the body (pp. 66-68).

Professor Wilson also performed the following, which has since been corroborated by other experimenters, on what is called "amphioxus," but more commonly known as "lancelet":

Let us suppose that at the eight-celled stage the group is put into a test-tube with water and violently shaken. The result is that eight cells are shaken apart and become completely separated from one another. Then a very remarkable thing happens. Most people would imagine that the immature creature must have been killed by such rough treatment, but such is not the case. Each of the eight cells, undaunted by what it has been through, sets itself to work, begins to divide on its own account and finally builds up a complete amphioxus. Let us consider what this means. A single cell, from the eight-celled groups, would under normal circumstances have constructed, one may roughly say, one-eighth of the future amphioxus. It might have been worked up into its tail, into one of its internal organs, into a variety of positions of the body. But under the altered circumstances it is able to construct and does construct an entire and complete new amphioxus. It was the consideration of phenomena of this kind which led Driesch, one of the greatest workers in this line, to declare that the egg seemed to act like an intelligent being. And the same thing

is admitted by Wilson in the preface to his great work where he says: "'One is sometimes tempted to conclude,' was recently remarked by a well-known embryologist, 'that every egg is a law unto itself!' The jest, perhaps, embodies," he continues, "more of the truth than the author would seriously have maintained, expressing, as it does, a growing appreciation of the intricacy of cell phenomena, the difficulty of formulating their general aspects in simple terms, the inadequacy of some of the working hypotheses that have been our guides" (pp. 65-69).

Experiments of this kind are what lead men in the biological fields, especially in embryology, to the belief that, if a cell will follow out a certain path which always leads to a very definite destination regardless of hindrances, there must be something besides pure chemistry and physics working within its tiny body.

Virchow, the father of modern pathology, said as long ago as 1887, "Never has a living being, or even a living element—let us say, a living cell—been found, of which it could be predicated that it was the first of its species. Nor have any fossil remains ever been found of which it could ever be likely that it belonged to a being the first of its kind, or produced by spontaneous generation" (p. 76).

And Hertwig, the eminent biologist, has recently said,

In the existing condition of science there is little hope that any worker will be able to produce the simplest manifestation of life in any artificial way from non-living matter. He has certainly no more chance of success in his endeavors than Wagner, in Goethe's "Faust" had of brewing Homonculus in his retort (p. 76).

And as Sir Bertram Windle then adds, that though all are agreed that at present there is no evidence whatever that life comes from the non-living, still,

Suppose we grant that living matter has always come from living matter, where did the first living matter come from? The world was once so hot that no living thing could exist upon it. It cooled down and a time arrived when life could exist. Where did it come from? It has been suggested that living matter might have been brought to this world from some other by means of a meteorite, but this view, even if likely, which is not the case, does not help us one bit towards the origin of life, since the living thing which travelled on the meteorites must have come from somewhere and the life to which it belonged must have had its commencement somewhere, somewhen.

Faced with this difficulty many men of science, unwilling to admit the possibility of a Creator, have claimed that, though spontaneous generation does not take place or cannot be proved to take place nowadays, yet it must have taken place at some former period, when conditions on the earth were far different from what they now are (p. 81).

And Professor August Weismann, one of the most distinguished biologists who recently passed away (1914), said "that spontaneous generation in spite of all vain efforts to demonstrate it, remains for me a logical necessity" (p. 82).

This is extremely interesting, in that the only reason there is a logical necessity in this instance, is of course, because the only alternative possible is to admit of a Creator. In the words of Reinke:

If we agree that living matter has at some time come from inorganic substances then, in my opinion, the Creation hypothesis is the only one which meets the necessities of Logic and of Causality and therewith answers to the needs of a prudent seeker after nature (p. 83).

Now let us look to the meanings of several words that are very prominently used in all scientific discussions. The word "adaptation" is so often used as an *explanation*, but this is doing about the same thing as making a personal

god out of Evolution, as, for example, when it is said "that Evolution explains this"—"Evolution explains that." "Evolution" isn't *anything* at all. It is the *name* of a *process* which we assume is the method by which certain changes took place. It doesn't exist by itself. It is simply the name of a PROCESS.

To make this distinction rather clear, we may use the story of a one-legged man of taciturn disposition sitting in the same seat with one of opposite temperament. Riding together for some time the talkative one asked how the other lost his leg, being told that only on one condition would the answer be given, and that was that no further questions were to be asked. Agreeing to this, the one-legged-man said "it was bit off." And if we substitute the word "Evolution" we get a very clear idea of what we mean by a process not being an explanation.

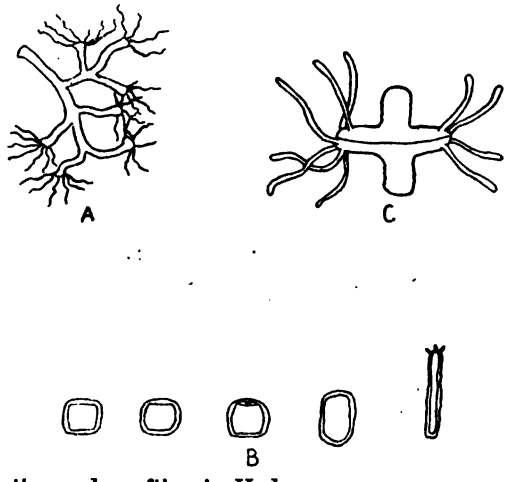
And so, when Professor Weismann, in trying to explain certain behaviour on the part of tubularia, says:

> This also appears to us to be adaptive, and does not surprise us, since we have long been accustomed to recognise that what is adapted to an end will realise this if it be possible at all,

and another time he says, "It was not worth Nature's while to make such adaptations" (p. 88), we have an explanation like the story cited above. It gives a name to something that happened and calls it an explanation. Any machine made for a certain purpose will, of course, perform that purpose, but WHY was the machine made for that purpose and what caused all the parts to be made as they were, in order that they would unify and always work out that purpose?

Remember that the mechanically constructed thing always

performs the same act in the same way, while the living thing never. The latter has considerable discriminative power even in the lowest forms, as witness, what Pauly[5] says regarding tiny, one-celled animals that pick always a certain kind of food among the many sea-plants about, and though some might suggest this is due to a chemical attrac-



Regeneration and grafting in Hydra.
A. Seven-headed *Hydra* made by splitting distal ends lengthwise.
B. A piece of *Hydra* regenerating an entire animal showing various stages in the process.
C. Part of one *Hydra* grafted on another.
(Hegner—A. after Trembley. B. after Morgan. C. after King.)

tion of some kind, to be logical, they would have to extend this idea to its ultimate end and apply it to the human family, but surely few of us would be willing to concede that our food-likes and dislikes are to be explained on the basis of pure chemical attraction.

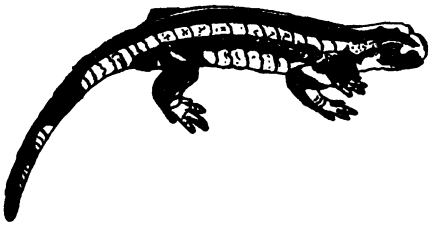
In "regeneration" and "repairing," sometimes also called "restitution," we have a most interesting concourse of won-

[5] Darwinismus und Lamarckismus, by Pauly (München 1905).

derful results obtained from various experiments.

The hydra is a little fresh-water creature described in practically all elementary zoological texts. If this animal is cut into two pieces, each becomes a complete hydra again.

If it is cut in many pieces, under favorable circumstances, each piece becomes a complete individual. If the head-end is bisected, we have a two-headed hydra, and the Abbe Trembley who performed these experiments found that he could continue this until he had an eight-headed hydra, with a single stalk or lower portion.



Salamander.

Later on Spallanzani found that the common earthworm would regenerate a new head or tail if cut transversely, but that it will die if it is divided longitudinally. While with the salamander, the same experimenter found

if the tail was cut off a new one would grow which would contain vertebræ—new vertebræ, of course—just like those which had formed the skeleton of the original appendage. Further, he showed that if a leg, or even all four legs, were cut off, it or they would grow again and that this process might be repeated time after time (p. 101).

He actually cut off the legs and tail of one salamander six times and each time they all grew during three summer months. And the last time they grew with just as great a rapidity as the first, so that

Spallanzani calculated that during these three months the animal under experiment had made for itself no less than 647 new bones, not to speak of all the muscles, nerves, and arteries which formed with the bones in question the various parts which were restored (pp. 101-102).

And in addition to this, the salamander can also regenerate his upper and lower jaws. This animal is a vertebrate, that is a back-boned animal; the hydra is an invertebrate, that is, one who does not have a back-bone. The vertebrate cannot be cut in little pieces, though in a more limited way, *it has the same powers that force the animal to become what it was intended to become,* regardless of its injuries.

Wolff's experiment on the water-newt should also be kept in memory. Here only the lens of the eye was removed, and though originally the lens grows from a totally different layer of the developing organism, now it actually grew a new lens from the outer layer of the iris, that is, the colored curtain, which in our eyes is blue, or grey or brown. This means that here is a case in which a lens came from a layer of cells from which no lens had ever come before, so far as any one knows.

The planarians or flat-worms, have a most wonderful power of regeneration, for in these one may cut off tail and head, and from the mid-piece thus left, there will emerge a new head and a new tail, while the head grows a new body and tail, the tail a new body and head.

Comparing this with a machine, we should have to produce a mechanical arrangement that

had a bad breakdown, setting to work to grow for itself a new wheel or to construct a new connecting-rod. Or we may picture a lathe which has had a wound inflicted in its side setting to and producing a new chuck from the incision (p. 106).

This would be wonderful enough and is hard enough to imagine, but still more difficult of mental imagery would be the state of affairs in which the wounded locomotive would resolve itself into its constituent steel and brass, and having done so should then, by the force of its own intrinsic powers, reconstruct a full, complete and working railway engine. Yet this is what is done in another form and the whole chain of occurrences is so remarkable and so forcible an example of the powers of living matter, as well as of their differences from those of non-living objects, that it may be given here at length.

Professor Driesch has made this experiment on clavellina lepadiformis, a

tolerably highly organised creature belonging to the class of ascidians placed by zoologists very near the lower vertebrates in the scale of animal life. It is about an inch in length and divided into three portions; the uppermost of which forms an extraordinarily large, basket-like gill, provided with an entrance and an exit for the water.

To this succeeds a small connecting body portion which contains part of the intestines and finally there is the so-called intestine-sac with stomach, intestine, heart, reproductive organs, etc. If we divide the body of a clavellina at the level of the connecting portion, so that the gill-basket and the intestinal-sac are separated from one another, either or both of these portions can in three or four days complete itself into an entire organism, since by means of true regeneration proceeding from the incision, the gill-basket makes itself an intestinal-sac and the intestinal-sac a gill-basket.

But the interest here lies in the manner in which this is brought about, which is totally different from the way any of the preceding examples have re-built themselves.

The organisation of the gill-basket, its ciliated clefts, its openings, etc., all gradually dwindle away. At the end of

five or six days no more organization is to be seen in these parts, which appear like white spheres, in fact, the describer states that when he first saw this condition he came to the conclusion that the clavellina was either dead or on the way to death. It was not so, however, for though the creature remains or may remain in this condition for two or three weeks, at last the day comes when it begins to clear and to stretch and then, after the end of two or three days, it is found that amorphous mass has once more become a complete ascidian with gill-basket and intestinal-sac. It has become a perfectly new organism which has no continuity with the parts of the earlier organisation, though it has with its material. Its gill-basket is not a derivative of the old one; it is very much smaller and fewer and smaller openings. What has happened is that the old organised gill-basket has returned to an indifferent substance and then, from this indifferent substance on embryological lines, a new smaller individual has been constituted. But this is not the whole story, for it is not merely the isolated gill-basket which can restore itself by means of this roundabout process, but, after having isolated the basket, it can be itself divided either into an upper and lower portion or into an anterior and a posterior bit and each of these portions will then go through the same process, that is, each of them will first of all return to the indifferent condition and then from that re-constitute itself into a new small ascidian (pp. 106-108).

The example of a locomotive falling apart into its constituent elements and then rebuilding itself as suggested is a fair comparison.

Surely there is *something* that makes all this happen in this way, and whatever that SOMETHING is we call the "Vital Principle." Is there any wonder that nearly all biologists now accept, as Professor Kellogg says, some parts of an Orthogenetic doctrine, that is, that there is an inner driving force, which if logically followed out, becomes this "Vital

Principle."

We wish to call attention to two words not yet mentioned, which are likewise often used as explanations but which are in reality only names for something we know nothing about, namely "immanent" and "inherent." To say that certain forces or what-not, may be inherent or immanent within some other object, tells us nothing whatever about what the forces are, nor where they came from.

But in objecting to "verbal explanations" the objection may be raised that a "Vital Force" is also only a verbal explanation. However, we may suggest that there is such a thing as "gravity," which is a "force," and there is such a thing as "ether" though we cannot see it. We can, however, know it by its manifestations—by what it does. As Professor Duncan says "ether is not visible to the eye of sense; it is visible to the eye of the mind which is much less liable to err" (p. 123). So that we might also say, that if the "vitalistic explanation is verbal only, so also is the theory of gravitation and so the existence of ether," or as Dr. Haldane, the distinguished physiologist has said:

It is frequently urged that Vitalism amounts to nothing more than the mere assertion that a physico-chemical explanation of vital phenomena has not been found; and that even though this assertion be correct, the only possible way to advance in physiology is by the further application of the principles of physics and chemistry, since there are and can be no other kinds of explanation but the causal ones which these sciences afford. *This argument in its widest form is undoubtedly based on the metaphysical assumption that the universe, interpreted as it is in the physical sciences as a universe of matter and energy, corresponds to absolute reality, and is for this reason incapable of any further interpretation.* The work of modern philosophy since Berkeley and Hume has shown that the assumption in question is without foundation. The italics are ours (pp. 123-124).

Regarding Energy, we may define it by saying it is the capacity for doing work, and is of two kinds, "Kinetic" or actual motion, as a running train, for example, and "Potential" energy meaning, the power to do work due to position, such as the weights in an old-fashioned clock, when the clock is "wound up"; and we have found through our physical experiments two so-called energy laws."

(1). That the sum of the kinetic and potential energies of any system of bodies remains constant; and

(2). That the sum-total of the energy in the universe remains the same. [6]

[6] Scholasticism and Modern Thought, by Rev. P. Coffey, Ph.D., Irish Theological Quarterly, October, 1909. Footnote, Page 459.

"Cf. Rickaby, *Scholasticism*, p. 100: The hope of Scholasticism as a philosophy for the future seems to rest on its alliance with Physical Science. Let scholastic metaphysicians be physicists, or with the physicists, and they may yet win back the sceptre from Hegel. Nor are the two families unconnected. The true ancestors of the physicists of to-day are not the Humanists of the Renaissance, but the Schoolmen of the thirteenth century. For scholasticism did make its endeavor by its own method and according to its own notions and opportunities to inquire into nature. Moreover, our physical science sadly needs the co-operation of some sound metaphysics; for though the two provinces be distinct, yet they are adjoining, and professors of physical science are continually making incursions into metaphysics, not always with the happiest results." As an interesting illustration of such incursion we may quote the following sentences from Professor R. K. Duncan's fascinating volume, *The New Knowledge* (London: Hodder & Stoughton, 1907, p. 263, 8vo. Price 6s net):—"If the universe is running down its available energy into uselessness, there must have been a precise moment of time, however far back we may place it, when the energy was *all* available, and when it was initiated in a sudden beginning by a single creative act. Consequently, there must have been a time behind which our present laws did not operate. Also there must be a time in future when the universe will have grown to a definite exhaustion and death. The death will come gradually, but the beginning must have been sudden and due to a creative act. If, on the contrary, the waste of energy is replaced by growth, the universe is immortal and eternal, both in the future and in the past. If the old conception is true, it is necessary to say, 'God made it, and started it at a definite time to run its course.' If the second conception is true, we may say, 'The Universe *is* God in one phase of Him, and it possesses His attribute of eternal duration.'" (p. 245). *May* we? About such a world the most we *could* infer (from the premises) would be its co-eternity as a creature with God, and dependently on Him as Creator: and such *participated* eternity of a

It is essential that we again call attention to the word "law" as here used. This does not mean a "law" at all, in the usual sense pertaining to matters of "right and wrong"; it merely means that, in as much as we see certain occurrences follow each other constantly, we have given this series of "following-occurrences" the name "law." It means only, that *as yet* we have found no physical experiment that has proven an exception to this series of occurrences.

And it is here that the opponents of Vitalism probably base their most insistent claim. We have shown how Professor Driesch overcomes it, but here is still another way. Sir Oliver Lodge says:

The term "energy" itself, as used in a definite sense by the physicist, rather involves a modern idea, and is itself a generalisation. Things as distinct from each other as light, heat, sound, rotation, vibration, elastic strain, gravitative separation, electric currents, and chemical affinity, have all to be generalised under the same heading (of the Conservation of Energy) in order to make the law true. Until "heat" was included in the list of energies, the statement could not be made; and a short time ago it was sometimes discussed whether "life" should or should not be included in the category of energy. I should give the answer decidedly No, but some might be inclined to say Yes; and this is sufficient as an example to show that the categories

creature is very different from the *essential* eternity of the Necessarily Existing Deity. "This (pantheistic conception), to most people of scientific training, is (the author continues) the more acceptable conclusion." If so, it is because their "scientific training" is so narrow and so specialised as to make them oblivious to the evidences for Theism and Creation to be found in the phenomena of the religious, moral and social sciences, apart altogether from Physics; and possibly because it has been the fashion in recent times to *assume* (without proof) that physical hypotheses point ultimately to Pantheism. The author himself seems, nevertheless, to recognise the existence of a Transcendent Deity as Creator of the Universe. "Meanwhile" (he writes, p. 257), "we feel that we know this—'In the beginning God created' and in the midst of His creation He set down man with a little spark of the God-head in him to make him strive to know . . ."

of energy are not necessarily exhausted; that new forms may be discovered; and that if new forms exist, until they are discovered, the Law of the Conservation of Energy, as now stated, may in some cases be strictly untrue, though partially and usefully true; just as it would be untrue, though partially and usefully true, in the theory of machines, if heat were unknown or ignored (p. 131).

This may all be summed up, by repeating what we have already said elsewhere, that a truth can only be arrived at after ALL THE FACTS have been gathered. A fact must not be confused with TRUTH. It is only part of Truth, and any fact may thoroughly upset any quantity of our speculations, though every one of these same speculations may have been just as true as possible from the viewpoint of the facts we then had at our disposal, *but, they were not the Truth.*

And our conclusions? The last word has not yet been said. In other words, all the facts are not yet in, so we had best hold our affirmations of pet theories in abeyance until they are.

Summing up both Professor Driesch's complex but very scholarly arguments, and Sir Bertram Windle's far more simple ones, we must and can only come to the conclusion from the facts we now possess that from the Scientific investigations so far made, after we have dissected and observed and analyzed, after we have applied every physical and chemical law we know, we find there is a "something over" which we have not explained, and from all appearances cannot be explained from, through, nor by purely physical laws.

CHAPTER IX

THE IDEAL

AS we have shown in the chapter on Logic as well as in the Chapter on Vitalism, all ability to prove anything must come from the world of THOUGHT; further, whenever we do any thinking at all, we must have Something to think about, which immediately presents to our consciousness the fact of a Thinking Subject and an Object thought about. We also called attention to still another fact, namely, that whenever we describe anything, for example, an orange, we speak of Attributes only, and that when we analyse this, we find that Attributes are only certain characteristics that the orange possesses—that is, there is a REAL something that possesses these characteristics—and this gives us the idea of Relationship, for, we always think of the orange as a Whole and its Parts.

Having got this idea of a Relationship from our analysis of our description of any object, we may call attention to another Relationship—that of time—which we obtain, not by thinking of a sensible object, but by thinking back on our own thoughts, for we may think of an event that is *now* taking place and one that *has* taken place, or even that *may* take place, which upon analysis, gives us a Relationship of time.

The distinction between thinking of objects that come under the senses and thinking back on our own thoughts, must always be held in mind in all philosophical discussions.

By Truth we mean the correspondence between our idea

of an object and the object itself, and all of these things together we call the common-sense viewpoint in philosophy, as contradistinguished from the doctrine of Empiricism, which insists that only those things can be known which one has already materially experienced, and the doctrine of Idealism, which simply casts aside the material world entirely.

We do accept, however, with the empiricist, that all our Intellectual ideas must have first come through the senses, but we believe that our idea of an object actually corresponds to what the object is—that is, that we can *actually know* the thing before us.

Further, we can see, from what has been said of attributes, that, they being characteristics of an object, we *must necessarily* have an object to which they belong, whenever we have any attributes.

Another way of saying this more philosophically, would be to suggest that as we find everything we know anything about, dependent on something else—we have the idea of "contingency"—which means that coming into our mind at the same time with every thought we may have, if we analyse that thought, we find a division into the two "categories" as they are called, of dependency on something else, which we call "contingency" and an "independent" something which is dependent on nothing else; for it is unthinkable to assume that there could be something dependent on something else that was in turn dependent, and so on indefinitely. Somewhere we should have to draw the line and find something that was not dependent, and then of course, we should have something "Independent" or what is often called "Necessary," for this Independent something must be absolutely Necessary or our very thoughts are worthless, and if this should be so, then we must accept the only conclusion

possible, namely, that we can never know anything.

From Professor Driesch's argument we have already shown that scientifically considered, nothing can possibly be greater than the thing from which it sprang—in other words, the egg-cell that is to develop into a complete human being, must already have the possibility of that development within its tiny body.

But this little egg-cell came from an adult body, that is, from a much more highly organised individual than it is itself, and driving this argument home, we must come to the conclusion that the very first living cell that ever existed, must have had within itself all the possibilities to which it ever has arrived or ever can arrive; and if this be true, then this first living cell, due to these possibilities, must have been at least *as complex*, if not more so, than any cell of the present time.

May this not be the reason why "protoplasm" which scientists originally considered one of the simplest, elemental compounds, has now come to be regarded as one of the most complex substances we know?

No one has yet been able to tell us what protoplasm is and it may be of interest to know that so simple a thing as water is not yet thoroughly known, notwithstanding the fact that the most elementary classes in chemistry assume such knowledge. [1]

[1] See Chapter on "The Physical Chemistry of Protoplasm," in Mathew's Phyysiological Chemistry. (Published by Wm. Wood & Co., New York, 1915.)

"What is water? It is a singular fact that the exact composition of this abundant substance, a *sine qua non* of life, is not yet known. That water decomposes into hydrogen and oxygen and that there are nearly, if not exactly, two volumes of hydrogen liberated to one of oxygen is common knowledge. Also, it is certain that water is formed by the union of hydrogen and oxygen. The simplest formula which can be written for water is H_2O, H-O-H, and this generally given as its formula, but there are many facts which show that water as it exists in the liquid and solid form and probably in the form of its vapor even

Again, we have been taught that higher forms come from lower ones in the biological world, but it would seem, from the reasoning above, that the reverse viewpoint would be the more logical, as this so-called "higher form" is only apparent and not "real."

We have shown also that the machine-theory cannot hold in any way whatever, and that there is a *purpose* displayed as shown by the study of the mere physical facts of re-generation to which we called attention.

But we know, also, that to take the simplest forms of raw material and produce a machine that will in turn produce anything, requires a very high type of intelligence, and if re-generation shows so conclusively that the object for which the thing in question was apparently designed, will again and again grow to fulfillment when injury has come to the organism, we certainly shall have to admit some intelligence somewhere or procure a new definition for the word.

So, if the first germ-cells had all the possibilities within them to which any of their descendents attained, there must have been an Intelligence behind it all, for, we must not forget that no thing can come from anything that is less than itself, so that this Intelligence must therefore be greater than all the Intelligence combined that now exists in the forms we know, for it follows, that all human intelligence must have been present in the first Human germ-cell as a possibility.

at 365°, which is its critical temperature, has a more complex formula. Its high critical temperature, cohesion, refractive, index and boiling point all show that the formula is more complex than H_2O. The molecule of water would be very light were the above formula true; it should boil at a low temperature, and have a low surface tension. Instead it has a very high surface tension, much higher than any of the hydrocarbons. Hence it is certain that the formula is more complex, at least at temperatures lower than 400°C." p. 190.

The arguments here used have been built up logically, just as all scientific discussions must be, from evidence presented in the laboratory, and in order that they may the more easily be kept in mind we shall group them in convenient form.

There has been no scientific advance toward an explanation of the *origins* of life.

No fact is of value, except in so far as it can be defined in terms of *meanings*.

Logic means correct reasoning.

Reasoning makes use of thoughts.

Analysing our thoughts we find:

A thinking Subject and an Object thought.

To describe, we must tear our object to pieces mentally, thus giving us the idea of the Relationship of the whole to its parts.

The descriptive parts are *always attributes, never the thing itself.*

Attributes cannot exist *unless something exists which has them.*

We have never been able to find anything that is not dependent on something else, in so far as this world of ours is concerned.

We, ourselves, are dependent on thousands of things.

But, driven far enough, we must come to some place in our thought, where something is found that is not dependent, for there can be nothing dependent unless there is something on which to depend, as we have just shown.

The abstract idea of this dependency on something else is called "Contingency."

But it is impossible to think of anything "contingent" without something "Necessary" on which the thing under discussion is contingent.

But, if this Necessary something were dependent on anything else, in any way, shape or manner, it, too, would be contingent, which would be a contradiction of terms and absolutely unthinkable.

Therefore, there *must* be something that is Necessary and *alone necessary*, for, were there two or more necessary things, one would be limited by the existence of the other, and consequently, being limited, would again be contingent, and therefore not necessary.

Now, if there is anything necessary in this sense, it must *always* have been necessary, for surely, if everything, everywhere, depends on something independent—something necessary—then there could have been no beginning to this necessary something, nor, so long as anything whatever exists, can there be an end. And this is what we mean by "eternal."

The Laboratory has given us our scientific law, that no thing can come from anything that is less than itself.

We have found a Unifying Causality which insists on making any part of the body become what it apparently was intended for, regardless of environment; that is, we have found an Inner Driving Force, *which brings into actuality whatever was purposed.*

We know that we ourselves are very complex adult forms and that we are intelligent, so that in accordance with what has gone before we must come to this final conclusion:

The First Cause must possess in an eminent manner, *all* the intelligence, all the complexity, all the purpose, there is in existence.

We find then, that though we may not be able to give any complete description of this First Cause, we must accept it as a logical necessity for all scientific reasoning, for without it, there is no science possible, because the only way we know anything at all is by taking the various attributes we find and then going back far enough to find what possesses them. So having established by laboratory proof and pure logic that there is a Necessary, Intelligent, Eternal, First Cause, let us see what more can be said from the purely experimental side.

We must not forget that all we are and can be comes to us only through that with which we are born (inheritance), plus what we obtain after birth (environment and training); consequently all the subject-matter of thought possible comes from our environment, though colored by our training, and reaches us only through the senses, for, not being born with thoughts, we must get our subject-matter for them after birth, and as we have shown, this can only come from environment and training, consequently through the senses.

Now, suppose we look at an object, be it picture, book, statuary, building, or what-not, immediately, we *know* that this object at which we are gazing is not the most perfect thing of its kind possible. We have, however, not been born with Perfection in us; we have not experienced Perfection in any form, nor have we been trained to know Perfection—yet, notwithstanding all this, we *do know* that there can be a more perfect thing than the one we are then perceiving, and this we call the "idea of the Ideal." But, we must get this idea from somewhere, and the only thinkable way of having obtained it, is that it is an attribute of whatever it is that has made each of us possible; and, knowing that we have this idea, it must follow that the cause of this Perfection of which we have but a hazy notion, though our conviction of having it is clear enough,—no existence being greater than its cause—*must* be absolute Perfection itself.

As will be observed, we have made use of Laboratory Science and Pure Logic only—that is, Pure Science, and this has led to the conclusions just mentioned, namely, that while we cannot know all about the First Cause, yet we are far from not knowing anything about it, for we can, by observation and experimentation and analysis, learn much about the attributes that this First Cause must possess, and from this, if thoughts and logic mean anything, draw con-

clusions for a valid and legitimate Philosophy of Life.

It will not be difficult for the student of the Sciences to follow our reasoning, but he will find his troubles in having schooled himself to think only in terms of the seeable and hearable, and, consequently, trying to translate this Ideal First Cause into some Physical Form. But this he cannot do any more than he can bring down a thousand and one things to physical forms. He must not make Professor Haeckel's mistake of thinking it necessary to assume a "gaseous vertebrate." All he must do is to know a logical and necessary CONCLUSION, without attempting to formulate this conclusion into some *form* that is seeable or hearable.

We need not say a God is impossible because we cannot imagine such a being, for the very simple reason that nothing that cannot be seen or heard or come under the senses in some way is imaginable; the very word means to be able to have an image, and an image is a copy of something that has come under the senses, and is then thrown on the screen of the mind. An electron, an atom and a molecule are unimaginable, though by no means unthinkable. In fact we have to think them or much of our science ceases.

Let us not forget either that to think along one pathway only soon brings about a state that makes it practically impossible to think along any other. This is well exemplified by Charles Darwin himself, who regretted that in his later years he lost all appreciation of music and the finer things of life, because he had permitted his mind to dwell so long on only one line of thought. We call particular attention to this fact because many are wont to draw the conclusion in other fields that because one can no longer appreciate certain forms of thought they are non-existent; but surely, none would say that because Darwin could not appreciate music, there was no such thing as music appre-

ciation in existence, and so we must not forget that the more difficult things to hold in mind, such as attributes and relationships, because they are difficult, and with some persons, seemingly impossible, are not on that account, however, non-existent.

Ether, now considered by many, the ultimate "substance" can be known only through its attributes and relationships, and the ultra-violet rays as well as the infra-red rays, which every scientist knows from laboratory evidence exists, cannot be seen by the eye, though they are colors.

Our very word Evolution means something immaterial—that is it means "*Becoming.*" It does not exist as a potato or a carrot exists; it exists as the *process* by which the potato or carrot comes to be what it is, exists. It would be well for the student to use the word "Becoming" instead of "Evolution" for a time, so as to bring this important distinction home to him.

And lastly, it is just as absurd to imagine that a single brain-cell of ourselves could have a complete understanding of our entire organism of which it is such an insignificant part, as it would be for any one of us, who probably do not even occupy so important a place in the universal scheme of things, as does the single brain-cell in the scheme of our body, to assume that he could understand or know *all* about the First Cause.

And thus far, and thus far only, it seems to the writer, can Science plus Logic go, and to this conclusion must it come. From here on the province belongs to Revealed Religion, and Science has no more to offer.

CHAPTER X

AUTHORITIES

IT is a common belief and one that is expressed all too often, that men have ceased to rely on *Authority* in our day and age and now insist on procuring all the evidence for themselves. But like so many popular ideas, this is very far from the truth. All that is meant by those who are capable of intelligently discussing this phase of philosophical argument is that the PAST *simply because it is past*, is not sufficient authority for anything, and further, that this is *only* in the Natural Science Realm, and *only* on such things as can be definitely proven in the laboratory. It has nothing to do with another order of things, such as Morals and Theology. This must always be remembered, and we have here an actual application of what our entire volume has been attempting to make clear, i. e., that simply because a certain individual is an authority in one field of work does not imply that he is at all proficient in another.

So, when we read of men who set aside "Authority in Science" all that is meant is that they refused to accept what had always been taught as true, unless there could be proof brought to substantiate it; in other words, that they refused to believe that because men had always done a thing in a certain way, or believed a certain thing from time immemorial, it has on that account been true. And all of us are indeed glad that this *kind* of authority was broken up.

But as to Real Authority, we must make use of it daily, for no man, no matter what his span of life might be, is

capable of proving every detail of life for himself, and so he must, by the very exigencies of life, accept thousands of things on the Authority of others. And in view of this fact it behooves us to find *who* is an authority so we may feel positive that we are not following false teachers. And it is just this interesting problem in the Biological field, that this chapter attempts to answer as objectively as possible.

The usual plan of writers is to quote only those who agree with them. This book has tried to quote both sides, letting the student come to his own conclusions. And so we have taken *every* name that is entitled to recognition for distinctive work in Biology and compiled a list for comparative purposes.

First, we have chosen for our guide the Eleventh Edition of the *Encyclopedia Britannica*, for this work has been edited and arranged under the supervision of the University of Cambridge, England, which institution is without doubt the most famous, and deservedly so, of all scientific schools in the English-speaking world. We have thus the advantage of having our Authorities in Biology chosen by the most eminent living scientists themselves, and observing what space they felt should be accorded to each.

Second, we have taken Professor Wm. Locy's book, *Biology and Its Makers*, the most complete standard work of its kind in the English language, and have procured from this a list of all names there mentioned, so we could be certain that none was neglected.

Third, we have taken the amount of space accorded each in the *Britannica* and placed all names in the relative order of importance, taking "space accorded" as an objective guide.

Fourth, we found, definitely stating the finding place, whether or not each of these men was a "believer" or not, as we wished to make this list of ALL biologists as valuable

to each reader as possible.

There have been articles and books written, picking out a certain number of scientists for or against some individual creed or belief, but as any side of any argument can produce several important names in its support, these writings have always seemed quite valueless. So, to overcome this narrower viewpoint, we have quoted them all, thus making valid comparisons possible.

As we have already stated in a previous chapter, the number of individuals for or against a thing has absolutely nothing whatever to do with the truthfulness of it, for, to come to the conclusion that because all men of science are "believers" or "non-believers" therefore the "believer" is right or the "non-believer," as the case may be, is just about as valid as having the ice-man lay out the diet for the family table and calling him in to prescribe when any member becomes ill. Religion and the Laboratory have nothing whatever to do with each other, and a Laboratory man has no more right to speak on Religion than has the ice-man on diet, and the reverse is also true, that Religion has no right to speak on whether a fact has or has not been found in the laboratory. That requires a laboratory man, BUT, after the fact is found, and we begin to discuss what the fact MEANS, then the Laboratory man is finished with his task, unless he also be a Philosopher, for this is the work of the Philosopher and the Philosopher alone.

And as very few of us are even remotely capable of uniting even two fields of learning, much less the three immense ones that we have just mentioned, Authorities loom up very large on our horizon, for, on every belief we have, we must know whom to look to as an Authority, first, as to whether our facts are correct, second, as to whether our meanings are valid, and third, as to whether the Creed we have laid

out for ourselves is properly supported by legitimate First Principles and a sound Metaphysics. Which means that there isn't a thing we can accept as true unless we have three Authorities in three totally different fields pass judgment. We are, of course, here speaking of any belief we hold that is founded on fact, and not fanciful, imaginary visions. We must have an Authority for every Fact found; we must have an Authority for the Logic of our Meaning; we must have an Authority for our Metaphysics, or First Principles.

And as all of us are doing our very best to obliterate superstition we are very anxious that none should adopt that most absurd of all superstitions of accepting as an Authority in one field a man who is only an Authority in another, for, after all, that is about all superstition means, namely, accepting something that isn't true on the Authority of some one who isn't an Authority.

Professor Joseph Jastrow has well said that people often wonder why experts disagree, when in reality they seldom do, but many and many a man *calls himself an "expert" who is not*, and disagreement is to be expected in that case.

So these tables will show who the REAL EXPERTS are, and a letter written by Professor Helmholtz, one of the greatest scientists of the just past generation, will make still clearer what we have here been attempting to bring home to the reader, that those who advertise themselves as great experts and able scientists and who obtain many followers, are not considered worthy at all by those who actually are capable of passing judgment.

This letter was written to Professor Helmholtz's father from the University of Berlin, on just such a subject.

"From your letter it appears to me that you entertain some suspicion that I endorse the trivial tirades of Vogt

and Moleschott. Not in the least. I must also earnestly protest against your ranking these two among the representative scientists. Neither has as yet proved by any scientific special research that he has acquired that regard for facts and that calmness in his conclusions which were obtained in the school of natural science. A cautious scientist knows full well that, because he has gained a somewhat deeper insight into the complicate working of the natural forces, he is for this reason not a bit more justified than any other man to give a verdict against the nature of the soul."

Great Names in Biology	Columns of Space Accorded in the Eleventh Edition of the *Encyclopedia Britannica*
Mendelism, (Mendel was an Augustinian Monk)	9⅓
Harvey, (Vitalist)	9¼
Huxley, (Brought up his children in the Anglican Faith)	7½
Darwin, (Was in doubt as to a God or not. See statement below.)	7
Spencer, (The beginnings of things were all accounted for by his "unknown")	5
Lister,	4¼
Oken, (Vitalist)	4
Servetus, (Christian. See *Catholic Encyclopedia*)	3⅔
Pasteur, (Catholic. See *Catholic Encyclopedia*)	3¾
Agassiz, (Believer. See *Encyclopedia Americana*)	3
Wallace, (Spiritualist. See his own writings)	2⅔
Linnæus, (Christian. See *Heroes of Science*, London)	2½
Ray, John, (Christian. See *Heroes of Science*, London)	2½
Koelliker,	2¼
Owen,	2¼
Tyndall,	2⅓
Virchow, (Believer. See sketch in *Encyclopedia Britannica*)	2¼
Bell, Charles, (Believer. See sketch in *Encyclopedia Britannica*)	2

Great Names in Biology	Columns of Space Accorded in the Eleventh Edition of the *Encyclopedia Britannica*
Berengarius, (Catholic. See sketch in *Encyclopedia Britannica*)	2
Haeckel, Ernst	2
Lamarck, (Catholic. See *Heroes of Science*)	2
Bois-Reymond (Catholic. See *Catholic Encyclopedia*)	1½
Bonnet, (Vitalist. See Article "Life" in *Catholic Encyclopedia*)	1½
Buckland, (Christian. See *Bridgewater Treatises* or article under this heading in *Encyclopedia Britannica*)	1½
Cuvier, (Christian. See *Heroes of Science*)	1¾
Haller, (Christian. See Kneller's *Das Christenthum u.d. Vertreter d. Neueren Natur Wissenschaft*, Herder.)	1¾
Lyell, (Christian. See *Heroes of Science*)	1¾
Buffon, (Christian. See *Heroes of Science*)	1⅓
Cohn, (Non-conforming Jew. See *Jewish Encyclopedia*)	1⅓
Gray, Asa, (Christian. See *Encyclopedia Britannica*)	1⅓
Galen, (Ancient Roman.)	1⅓
Malpighi, (Catholic. See *Catholic Encyclopedia*)	1¼
Smith, Wm. (Christian. See *Heroes of Science*)	1¼
Baer, von. (Believer. See Kneller's Volume, quoted above)	1
Bichat, (Vitalist. See Table of Vitalists, following)	1
Brown, Robt.	1
Darwin, Erasmus,	1
Gesner, (Christian. See *Heroes of Science*)	1
Goodsir,	1
Hooke, Robt. (Christian. See *Encyclopedia Britannica*)	1
Leeuwenhoek, (Vitalist)	1
Ludwig,	1
Mohl, von	1
Suarez, (Catholic Priest. See any encyclopedia.)	1
Bernard, Claude (Became an infidel but later became a Catholic. See *Catholic Encyclopedia*)	¾

Great Names in Biology	Columns of Space Accorded in the Eleventh Edition of the *Encyclopedia Britannica*
Quatrefages, (Christian.)	¾
Galton,	¾
Romanes, (Looked at the Christian side far more favorably as he grew older. See Tables further on.)	¾
Schwann, (Catholic. See *Catholic Encyclopedia*)	¾
Spallanzani, (Catholic Priest. See *Catholic Encyclopedia.*)	¾
Balfour, (Christian. See any of his Philosophical Writings.)	⅔
Boerhaave,	⅔
Koch, Robt.	⅔
Gegenbauer,	⅔
Caesalpinus, (Christian. See *Catholic Encyclopedia*)	⅓
Cope, (Believed in a Creator. See *Encyclopedia Americana*)	⅓
Schleiden,	⅓
Schultze, Max	⅓
Swammerdam, (Christian. See *Heroes of Science*)	⅓
Whitney,	⅓
Aldrovandi, (Christian. See *Catholic Encyclopedia*)	½
Carpenter, (Christian. See *Encyclopedia Britannica*)	½
Ehrenberg, (Christian. See Kneller's Volume, already cited)	½
Grew,	½
Marsh, O. C.	½
Milne-Edwards,	½
Mivart, St. George, (Catholic. See *Encyclopedia Britannica*)	½
Müller, Johannes, (Catholic. See *Catholic Encyclopedia*)	½
Weismann,	½
Zittel,	½
Fabricus, (Catholic. See *Catholic Encyclopedia*)	¼
Fallopius, (Catholic. See *Catholic Encyclopedia*)	¼
Siebold, von,	¼
Steno, (Catholic Bishop. See *Catholic Encyclopedia*)	¼
Wolff, (Vitalist. See List of Vitalists)	¼

Table of Biologists who have done valuable work, but, up to 1910 *have not been deemed worthy of a separate article in the Eleventh Edition of the Encyclopedia Britannica.*

de Bary, H. A.
Ramon y Cajal
Calkins
Carpi (see *Catholic Encyclopedia*)
Castle
Columbus (see *Catholic Encyclopedia*)
Davenport
Dufour, Leon
Dujardin
Dwight (Catholic. See his "Thoughts of a Catholic Anatomist")
Geer, de,
Eimer
Hertwig, Oskar. (Opponent of Weismann)
His, Wm.
Johnston
Klein (see *Jewish Encyclopedia*)
Kowalevsky
Lacaze-Duthiers
Leidy
Lesser
Leuckart
Leydig
Loeb
Lyonet
Mecket, J. Fr.
Müller, Fritz
Nägeli (Vitalist)
Needham (Catholic Priest)
Newport
Osborn
Pander
Pearson, Karl
Pouchet

Purkinje
Rathke
Reaumur (Christian. See *Heroes of Science*)
Redi (Christian. See *Catholic Encyclopedia*)
Remak (Jew. See *Jewish Encyclopedia*)
Roesel
Saint Hilaire (Christian)
Schaudinn
Schultze, Franz
Severinus (Pope)
Strauss-Dürckheim
Vesalius (Catholic. See *Catholic Encyclopedia*)
Vicq d'Azyr
Vinci, Leonardo (Catholic. See *Catholic Encyclopedia*)
Vries, de, Hugo
Willoughby (Christian. See *Heroes of Science*)
Wyman, Jeffries
Wasmann, Erich (Catholic Priest)
Wheeler (Vitalist. See his writings)

Table of Vitalists as per Professor Han Driesch's History and Theory of Vitalism.

The names that follow are the most representative Vitalists, that is, are the names of those who are convinced that Life cannot be explained by a causo-mechanical process. They insist on a "Vital Principle," which, however, many of them call by different names, such as "Entelechy," "Genetic energy," "Property of self-adaptation," "Growth," "Bathmic force," "Direction," "Biotic Energy," or, as the older writers called it, a "Soul," though it must be observed that most of these writers, as Sir Bertram Windle has well said, would rather perish than give it that antiquated name.

Aristotle
Helmont, van J. B. (1577-1644)
Harvey, Wm. (1578-1657)
Stahl, George Ernest (1660-1734)
Buffon, George, Louis, Leclerc (1707-1788)

Maupertius (1698-1759)
Needham, Tuberville (1713-1781)
Wolff, Caspar, Friedrich (1733-1794)
Blumenbach, J. F. (1752-1840)
Bichat (1771-1802)
Keyserling
Hegel (1770-1831)
Schelling (1775-1854)
Cuvier (1769-1832)
Goethe (1749-1832)
Humboldt, von Alexander (1769-1859)
Oken, Lorenz (1779-1813)
Reil, J. Ch. (1759-1813)
Treviranus, G. R. (1776-1837)
Autenrieth, M. F. (1836-)
Tiedemann, F. (1830-)
Burdach, K. F. (1835-)
Baer, von Karl E. (1792-1876)
Wagner, R. (1805-1864)
Magendie, F. (1816-)
Müller, Johannes (1801-1858)
Liebig (1846-)
Schopenhauer, Arthur (1788-1860)
Hanstein, von J. (1880-)
Wigand, Albert
Hartmann von Eduard (1842-1906)
Liebemann, Otto (Regards Vitalism as a Possibility)
Pflüger (Partly a Vitalist) (1877-)
Goetz (Partly a Vitalist) (1869-)
Busse
Montgomery, Edward
Roux, W.
Ehrhardt, F. (1890-)
Wolf, Gustav
Cossmann, P. Nikolaus
Reinke, Eugen
Noll, Fritz
Pauly (absurd theory, but Vitalistic)
Schneider

Ostwald
Gurwith
Bergson
Lotze
Bunge, von G. (Problematic Vitalist)
Bernard, Claude (Vitalist, but is seemingly inconsistent)
Descartes
Leibnitz
Bonnet
Haller, Albert
Spallanzani

These last five, however, do not believe there is any mutual interaction between soul and body.

Special Tables of the Most Important Biologists

Professor Wm. Locy's summaries of great names.

Aristotle	Lamarck
Galen	von Baer
Vesalius	Müller, Johannes
Harvey	Schwann
Malpighi	Schultze, Max
Linnæus	Darwin
Wolff	Pasteur
Cuvier	Zittel
Bichat	

From our Table compiled from the Encyclopedia, it will be seen that all of these except Schultze and Zittel, regarding whom we could find nothing as to their beliefs, were "believers" and Darwin is doubtful.

And here is another list of FOUNDERS of the various branches of Biology. For to these men all that has come after their time is due, for, as Professor Locy well says, of those that came after Vesalius, they "had the advantage of the sketches made under the direction of Vesalius. Pioneers and Pathbreakers are under special limitations of being in

new territory, and make more errors than they would in following another's survey of the same territory; it takes much less creative force to correct the errors of a first survey than it does to make original discoveries."

Founders of Biological Divisions

Malpighi, founder of Pathology.
Virchow, founder of Modern Cellular Pathology.
von Baer, founder of Embryology.
Müller, Johannes, founder of Modern Physiology.
Schwann, founder of the Cell Theory.
Pasteur, founder of Bacteriology.
Bichat, founder of Histology.
Lamarck, founder of Modern Evolution.
Darwin applied this to man.
Cuvier, founder of Modern Comparative Anatomy.
Linnæus, founder of Modern Botany

Again, it will be observed that every one was a "believer," with Darwin alone doubtful.

Tables of Modern Scientists in Various Fields of Research

Physicists (from Kneller's volume and Schwickerath's Article)

Benjamin Thompson, American, afterward Count Rumford of Bavaria
Sir Humphrey Davy
Robert Mayer
Joule
Hirn
Clausius
Thompson (Lord Kelvin)

The first five established the "mechanical theory of heat and the law of the conservation of energy" while the last two drew the "conclusions from these laws which bear on the whole universe."

In regard to their views on religion, *Every One* of them

has in his writings shown not only unmistakable evidence of a firm faith in Christianity, but from their writings one can in all truth say, went out of their way to let people know it.

Not one of the establishers of this great law was a defender of materialism, though Ernst Haeckel considers this same law "paragraph I of the monistic religion," so we must with Father Schwickerath, from whom we quote, say, "we must suppose, and Haeckel should suppose as well, that these men knew a little more, and certainly not less, about the bearing of this law than Haeckel himself."

Mathematicians

Cantor (died 1783)
Gauss (died 1855)
Cauchy
Vicaire
Binet (died 1856)
Puiseux (1883)
Hermite (1901)
Buoncompagni
Professor Weierstrass of the University of Berlin (1897)

All illustrious mathematicians and every one a believer; several of them extreme defenders of the Faith and most of them Catholics. Cauchy wrote a pamphlet in which he said: "I am a Christian, i. e., I believe in the Divinity of Christ with Tycho Brahe, Copernicus, Descartes, Newton, Fermat, Leibnitz, Pascal, Grimaldi, Euler, Guldin, Boscovich, Gerdil; with all the great astronomers, with all the great physicists, with all the great mathematicians of the past centuries. I am a Catholic, a sincere Catholic, as were Corneille, Racine, La Bruyere, Bossuet, Bourdaloue, Fenelon."

Among *Astronomers* we have:

Father Piazza, who discovered Ceres, the first of the planetoids, which discovery is really a very important one in astronomy.

Father Oriani.
Inghirami, a member of the religious order of the Piarists.
Cecchi, also a member of the same order.
Denza, a member of the Barnabites.
Koller, a Benedictine.
Reslhuber, a Benedictine.
de Vico.
Perry.
Secchi, all three being Jesuits.
Olbers.
Bessel, both of whom speak in their letters of God so that all idea of materialism must be excluded.
John Frederick William Herschel was a believer and thoroughly pious. (See article in the *Dictionary of National Biography.*)
Leverrier (1877) Discoverer of Neptune.
Faye, the distinguished French astronomer (1902). (See his work, *Sur l'Origine du Monde,* where he speaks of biblical creation.)
Lamont.
Kreil, both devout Catholics.
Professor Heis of Münster (1877) ardent Catholic and defender of the faith.

In Electricity

Galvini	Ohm
Volta	Siemens
Ampere	Oersted
Faraday	Maxwell
Coulomb	de la Rive

Nearly all the great men in electricity were Christians and most of them Catholics. (See *Catholic Encyclopedia,* and Dr. James Walsh's *Makers of Modern Electricity.*)

Father Kneller, in his volume, from which we have been quoting, says most eloquently: "The half-educated man who is smoothly borne along the street in an electrical car, who from his room converses with his friend miles distant and recognizes his voice, who sends a message to America

from Australia, far in advance of the fastest train or steamer, this man often smiles with a superior and sneering look when he sees an old woman telling her beads, or when the conversation turns on priests and the church, and he thinks that the great discoveries of this age of electricity have given the death blow to the old religious prejudices. But by so thinking he betrays his own ignorance; he forgets that the great intellects to whom, in the first place, these great modern achievements are due, have humbly meditated on, and bowed before, the truths of Christianity. And in the clever hands under whose touch the hidden forces of electricity first manifested themselves have often closed in humble prayer, and in the instance of Volta and Ampere, have even not disdained to hold the beads."

Maxwell, who died in 1879, said to Mr. Colin Mackenzie, "Old chap, I have read up many queer religions: there is nothing like the old thing after all," and "I have looked into most philosophical systems and I have found that none of them will work without God."

In Optics

Fresnel
Fraunhofer
Foucault
Ketteler of Münster (died 1900). All believers.

In Natural Science

Biot
Regnault
Desains
Becquerel
Plateau
Tait
Jolly.

All of whom were Christians.

Chemistry

Dalton
Berzelius

Chevreul
Dumas
Liebig
Chaptal
Schönbrin of Basle
Wurtz
Klaproth
Friedel
Henry
Deville

All but one Christians and not even he was a materialist. Liebig "mercilessly condemned the attempts at utilizing the natural sciences as props to materialism. He says that such attempts are not made by the real scientists, but by 'dilettanti who from their promenades on the borderlines of science think themselves justified to expound to the ignorant and credulous public how the world and life in it have originated, and how wonderfully man has progressed in the exploration of the sublimest things. And the ignorant and credulous public believes these people and not the real scientists.'"

Geographers

Ritter
Daniel
Maury
Freycinet
d'Abbadie
Hauy (called the father of scientific crystalography)
Fuchs of Munich
Beudant
Hausmann

All believers and Hauy was a priest.

Geology and Paleontology

de Luc
Cuvier
Fuchs

Buckland
de Derrer
Miller
Hitchcock
MacCulloch
Pfaff
Dana
Waagen

Every one of whom tried to show a harmony between revelation and geology. Some even went entirely too far in their attempts.

Conybeare (an Anglican Clergyman)
Sedgwick (an Anglican Clergyman)
Beaumont
Bischof
Fraas
Studer
Quenstedt
Daubree
Dumont
Barrande
d'Omalius
Lossen
Lapparent
All of whom were believers.

In Physiology

Johannes Müller (the greatest Physiologist of all times)
Schwann (founder of the Cell Theory)
Wagner
Volkmann
Vierordt
Claude Bernard (became a Catholic before his death)
Flourens (also a free-thinker for a time, but returned to his faith, Protestant, before his death)
Pasteur (father of Bacteriology)
Carnoy (the Begian biologist, was a priest)

Ehrenberg (pioneer in microscopic zoology, thought that materialism was a "humbug and a fantastic, sickly tendency of our time, which parades under the name of science")
von Baer (one of the most versatile of great scientists, father of Embryology, noted in zoology, geography, ethnography and anthropology, always a firm believer in teleology, for a time a pantheist, but later coming back into the fold)
Agassiz
Van Beneden
Altum (Zoologist and priest)
David (Zoologist and priest)
Heude (Zoologist and priest)
Latreille (Entomologist and a priest)
von Martius (Botanist who ordered a green cross to be placed on his shroud because, as he said, "A cross, because I am a Christian; green, in honor of botany")
Kielmeyer (Botanist)
von Schrank (Botanist and priest)
Leunis (Botanist and priest)
Castracane (Botanist and priest)

In Evolutionary Science Particularly

Lamarck
Saint Hilaire, both of whom founded the theory of Evolution in its modern form, and the latter of whom saw in it a "further step towards a deeper knowledge of God."
Ampere
d'Omalius
Waagen
Lossen, all of whom were Catholics, defended it strenuously. (They did not, however defend Darwinism, and as we have shown in our chapters dealing with this problem, Darwinism is not held in very high esteem in the scientific world, so these men were more nearly correct than were the more rabid defenders of the theory that swept so many off their feet.)

Darwin, "vacillated between atheism and theism," as shown by what the Duke of Argyle says regarding him: "In the course of that conversation, I said to Mr. Darwin, with references to some of his own remarkable works on the 'Fertilisation of Orchids,' and upon 'The Earthworms,' and various other observations he made of the wonderful contrivances for certain purposes in nature—I said it was impossible to look at these without seeing that they were the effect and expression of mind. I shall never forget Mr. Darwin's answer. He looked at me very hard and said, 'Well, that often comes over me with overwhelming force; but at other times,' and he shook his head vaguely, adding, 'it seems to go away.'"

Asa Gray, a firm believer and he actually wrote a book to show that Natural Selection did not oppose Natural Theology.

We had intended giving only a complete list of *all* Biologists, so that the percentage of believers and non-believers could be observed at a glance. We have done this, but found so many interesting names in other fields, and sometimes the same name, appearing in several of the sciences, that we thought these added pages would serve some purpose in at least acquainting those who are unfamiliar with either the names or the sciences with an excellent list that could be used as a sort of foundation for a "reading course."

We wish to call particular attention to the list of Biologists. It is especially among workers in this field that men who do not know are always telling us, all the recruits for materialism, atheism, and causo-mechanism are found. We have made as thorough an investigation as was within our means, and have not found over four instances in which any of the entire list there cited actually stated that the causo-mechanistic explanation was sufficient to account for Life. We have not been able to find anything whatever regarding many of the names as to their religious belief

and conviction, but if among those accorded a separate account under their own name, we find so vast a majority believers, we can apply the same percentage to those for whom we could find no biographical sketch, and surely the result is astonishing to us all.

There is, of course, an objection that can be raised, and that is that there were many able men who did defend materialistic views, such as Virchow, Du Bois-Reymond, Berthelot and others, but it is again astonishing to note how many of the scientists who in the beginning defended such views came to change them as they grew older and the first excitement of youth had given way to maturer judgment. "Haeckel has recently lamented such a change in the case of prominent naturalists of the materialistic camp. As instances of such 'psychological metamorphosis,' he quotes, besides Kant, such naturalists as Virchow, Du Bois-Reymond, and Wundt. He states with regret that Virchow, originally a materialist, who in 1856 expressed his conviction that he would never change his opinions in this respect, by his subsequent actions showed that his 'former conviction was a grave error; for twenty-eight years afterward he defended radically different opinions.' Wundt styled the first edition of his *Lectures on the Soul of Man and Animals*, thirty years later 'the sin of his youth,' and in the second edition he advanced entirely different views. The first edition was purely monistic and materialistic, the second purely dualistic and spiritualistic. It is possible that Haeckel's expressions are exaggerated, but they prove this much, that these eminent scientists became the more cautious in condemning the 'spiritualistic' views, the more they advanced in the knowledge of psychological phenomena."

Here is still another list of Scientists who were also de-

voted churchmen, compiled by Professor J. A. Zahm, of Notre Dame University.

Catholics

Astronomers

Leverrier
Faye
Father Secchi
Father Denza
Father Ferrari
Father Perry
Father Searle
Father Hagen

Botanists

Tulasne Greene
Edward L. Greene

Geologists

Barrande
Gaudry
Dumont
d'Homalius d'Halloy
Collet
de Lapparent
de la Valles, Poussin
Charles Sainte-Claire Deville

Chemists

Barf
Renard
Dumas
Berthelot
Chevreul
Henri Sainte-Claire Deville

Mathematicians

Chasles
Puiseux
Cauchy
Gilbert
Hermite

Prehistoric Archeologists

Abbe Hamard
Abbe Delaunay
Abbe Beroud
Abbe Bourgeois
Abbe Ducrost
Abbe Arcelin
Abbe Cau Durban
Marquis de Nadaillac

Protestants

James Clerk Maxwell
Gabriel Stokes
P. G. Tait
Sir William Thompson
Asa Gray
J. D. Dana
Quatrefages
Dawson
Joseph Henry
Fresnel
Liebig
Mayer
Sir David Brewster
Dr. Whewell
Adam Sedgwick
Sir Roderick Murchison
E. Hitchcock
Sir John Herschel
Michael Faraday

Taken from Catholic Science and Catholic Scientists, by Rev. J. A. Zahm, C.S.C., Professor of Physics in the University of Notre Dame, pub. by H. L. Kilner & Co., 1894, Philadelphia.

In comparing the "believers" with the "non-believers," we have found six who can without hesitancy be classified as believing that the Causo-mechanistic idea is alone sufficient to explain life, and these are: Spencer, Huxley, Haeckel, Ludwig and Loeb and Weismann. That there are others is to be conceded, but we have not found them. We have, however, been able to find that among those whose biographies were contained in separate articles, that is, among the GREATEST of all biologists, the overwhelming majority were and are believers.

Many of the biographies have touched but little on biology, for often the same man did most exceptional work in one field that is stressed on that account, and is barely mentioned in the field we are considering, which makes the list arbitrary, as all such lists are bound to be, but, nevertheless, the method we have used in compiling our names is the only objective one we know.

John Hunter has 10¾ columns assigned him, but Mendel's account is entirely on biology and Hunter's is not, so that Mendel has a greater space accorded him than Hunter in Biology, or for that matter than any biologist who ever lived.

This list will prove interesting when one contemplates what is usually written by those who do not know, regarding the non-belief of scientists, especially in the biological world.

We believe with Professor Swift of Washington University that *styles* in thought like other decrees of fashion are set by the leaders of the groups of men with whom

one is accustomed to associate. When erroneous scientific statements are made, it is therefore easy to grade the kind of intellectual associates with which the speaker is familiar, for he has obtained his information and his thoughts from the popular magazines and Sunday papers, or similar "non-authorities" in regard to science. The reader of such articles assumes that, because the article and the journal or paper is well advertised, that therefore the articles must be authoritative, is working entirely in the principle expounded in *The Hunting of the Snark* where someone says, "What I tell you three times is so."

Repetition and constant seeing or hearing a name in connection with a science carries with it the conviction to most men that such an individual must be very important in that particular field.

We do not believe that these lists prove anything whatever as to the validity or its opposite of any religious views, and, so far as we can see, it is only of interest as a guide showing *whom* to accept as an Authority, and to refute the popular but nonsensical ideas that scientific men are opposed to religion or are even non-religious.

CHAPTER XI

SUMMARY

SUMMING up the chapters that have gone before, we may point to the following important facts that we have attempted to impress upon any student of the Sciences:

Why the Philosopher, who was the acknowledged great man of the past is no longer so considered by men at large.

Why we now accept laboratory evidence alone for our *Facts.*

Why Facts must never be confused with Meanings—that is, there must be no confusion between the Fact itself, and what the Fact stands for.

That Meanings are all Mental, and therefore do not come under the Natural Sciences at all, but can come only under that branch of Philosophy called Psychology.

That Psychology is divided into two parts, the Rational or Philosophical, and the Experimental, sometimes also called Physiological.

That no one, therefore, who does not know both the Factual evidence and the Philosophical interpretations, or at least the Philosophical method of checking up interpretations, has any moral right to an opinion on the subject in question.

That a laboratory man, such as a Biologist, Chemist, Physicist, etc., may and should speak with authority on his findings, but that after he has developed a theory, he must, because every theory to be worth anything must be logical, we repeat, he *must* go to the Logician to find whether his theory is sound and whether it has been validly drawn from the facts at his disposal.

That even after doing this, he must go to the General

Philosopher to find whether he has started with correct First Principles, for, even though his facts and his theory be correct and logical, he may find that there were no grounds for his original premises.

That a theory is first originated, and then experiments are performed to find whether there are any exceptions to it, and not as is usually supposed, the facts found first and then the theory propounded, for every deliberate experiment ever performed, has been performed with the idea of proving something, or trying to find out whether something is true—in other words—to demonstrate a theory.

That, in view of the fact that Psychology has come down to the laboratory, and attempted to test the reactions of the nervous system under particular circumstances, we have found a sort of middle ground by which we have a connecting link between the Observer and Experimenter and the Philosopher.

That through Genetics we have been able to find and have been able to prove by laboratory evidence, that all men do not respond to the same stimuli in the same way, and that just because there is a difference between them, it does not mean that one is any better or worse than the other.

That we must therefore never make the error of assuming that just because two things are different, one must on that account be superior to the other. They are simply different.

But, that this being true, we must go about presenting even our facts differently to different types of people, if we wish them to see the same thing, and consequently

That it is absurd to condemn another manner than one's own in presenting facts, provided always they be facts, as is so often done by both sides, especially in biological and theological treatises.

That simply because one's teachers have all agreed on a certain point does not make that point of view true or untrue, for one is more than likely to find at one school only those men who think very much alike, because the head of

the department usually, if not invariably, sees fit to employ or recommend only those who agree with him. In fact often, it would probably be found that those in the same department come from the same schools or were pupils of the very man in charge.

That to find references in a volume, on no matter what subject, usually means only references to other writers who agree with the author who quotes them, and therefore to read a hundred such volumes may be narrowing, rather than broadening.

That there is no viewpoint that does not have its opponents, and that just because a thing is popular does not make it true.

That Truth means the agreement between our idea of a given thing with the object itself.

That a Fact is only one very small portion of a truth and must never be confused with it.

That until all the facts are in, we cannot have the proper correlation of truth.

That it does not follow that because we cannot know all about anything we can know nothing about it.

That the gathering of facts is of value only in so far as we can find meanings for them, and then apply them to humanity at large.

That as Professor James says, as soon as we get away from the very narrow work of just hunting for a few facts along one line, we must try to obtain a world-viewpoint, and as soon as we do this, the biggest thing that looms up before us, is the problem of Metaphysics.

But, this does not imply that we must cast our hypotheses to the winds.

Nor does it imply that our hypotheses are true.

We must accept a working hypothesis to be able to accomplish anything in laboratory work, regardless of whether it be true or not, just so long as our experiments work as though it were true.

That the student must be shown, that it is only on account of the immense amount of disagreement between men at large on all problems, we have come to an *agreement* as

to where we shall start our sciences, *But* this agreement has nothing whatever to do with whether there is anything beyond that starting point. It means only, that we shall not discuss it *in* the laboratory, because it is *beyond* the laboratory. In other words, because we have agreed as laboratory men only to discuss what we can find presented to our senses in the laboratory does not show, nor has it anything whatever to do with WHY our senses perceive things as they do, nor on what grounds we accept the evidence of our senses. All of these things are left for the realm of Philosophy, where they rightfully belong; for these things are Psychological and not sensible, and the laboratory cannot deal with things which do not come under the senses.

That, after all, Facts make little difference to any of us in and of themselves. The MEANINGS are what count and these lead to the propounding of our many theories.

Theories, then, are what actually *count*, because every fact we try to find or have found every thought we think or have thought, has been for some theoretical purpose.

But, Theories must be LOGICAL if they are worth anything, and Logic must be rigorously adhered to if we expect to be reasonable in our interpretations of facts.

So that to demolish any theory, all that is required is that it be shown to be illogical, and no laboratory man is needed for this purpose, but a Logician.

We all agree that each man must and can pass judgment validly on subjects propounded in his own field. We rightfully resent a theologian telling us about a biological *fact*, unless he be a biologist also, and so we must as justly resent a biologist telling us anything about philosophy and theology unless he be trained in these sciences as well.

That this is best exemplified in Evolutionary Science where so much is written on both sides without much foundation in fact, and where theories are so often illogically drawn.

That we can readily understand why, this being an age of "specialization," the average laboratory worker has had practically no training at all in philosophy and so cannot

draw up a theory in accordance with the rules of that science, though we must not forget that all writers insist that every particle of evidence must be Logical, that is—Philosophical.

That most biologists, with the exception of Professor Fleishmann, agree that there is Evolution.

That, notwithstanding this agreement, very few agree on HOW it all has come about.

That Evolution must never be confused with a THEORY OF EVOLUTION, for "Theory" here means only one way of HOW IT CAME ABOUT, and does not mean the same thing as Evolution.

That Evolution is a PROCESS and not an Object, in other words that it means BECOMING.

That Darwinism must not be confused with Evolution; for Darwinism is only one Theory of How Evolution came about.

That Charles Darwin was not a Darwinian.

That Darwinism is not held by very many biologists now.

That Huxley, the greatest defender of the Darwinian Theory was himself not a believer in it, but defended it against *unfair* attacks.[1]

That de Vries' theory of Mutation is probably accepted to a greater extent than any other single evolutionary theory. This holds that any changes which have taken place have usually come by sudden leaps or bounds rather than by slow continuous growths.

That this being so, it is and always has been absurd to look for a missing link, seeing there could be no missing link when there were no links in the process.

That there is not one particle of evidence that Man came from an animal ancestor.

That all evidence on this score has been one-sided in that it took only physical comparisons, leaving out the psychical.

That practically all Animal Psychologists have come to the conclusion that there is a decided difference between animals and men on the *psychical* side and that by no process yet come to light can this difference be bridged.

That animals *never* think, but work by instinct and asso-

[1] See Footnote 3, Chapter VI.

ciation, and always react in very nearly the same way to the same stimuli, and that all animals of one species always do everything in practically the self-same way, and have ever done so.

That man responds in *various ways*, and that there has never been one particle of evidence that an animal ever formed a concept of a thing as a whole.

That Professor Haeckel himself has noted the tendency amongst biological workers who have also studied the psychical side of life, to reverse their viewpoint from that which they originally held regarding a purely mechanistic explanation of life.

That Orthogenesis is now accepted in some form or another by nearly all biologists, and means that there is an inner driving force that makes the living organism do what it does.

That more and more the Vitalistic doctrines of a separate Life-Principle comes to the fore and is being accepted by an evergrowing number of scientific men.

That we are as far away from explaining life as we have ever been, as shown by Dr. Ward's statement.

That to account for the wonderful regenerative processes mentioned, there must be an Autonomous Life-Principle assumed.

That this same Vital-Principle has been given many different names by different writers, but in the last analysis it means the SOUL.

That if we analyse our every thought, we readily see that we have a thinking self and an object thought about.

That we also find a relationship between the Whole and its Parts.

That from what we have shown, it is seen that no attributes can exist unless they be attached to something on which they are dependent, thereby illustrating what is meant by the two words "dependent" and "independent."

That what is not independent must be dependent on something else.

That we know ourselves to be dependent on thousands of things, and *must* therefore be dependent on something

greater than ourselves,

For, nothing can come from anything else that is less than itself.

Showing, that a Cause must virtually contain all that it ever can produce; in other words, that that into which a thing ultimately develops must have been present in the very first Germ as a possibility, so that the first Germ was in reality more complex than the last development, though *seemingly* the reverse is true.

That as nothing can possess anything within itself that was not already present in its Cause as a possibility, therefore, as we have intelligence, the Cause which produced us, *must* be intelligent.

That as we KNOW *perfection* though never having experienced it, we must also have obtained this from the Cause which must have possessed it in order that it could be given. This Cause for want of a better name, we call the First Cause.

That thus far and thus far only can Logic and Laboratory science go.

From here on Natural Theology and Revealed Religion take up the thread and continue in logical order to develop their theses, while the biologist's and psychologist's work is done.

Here are several things that it is very important to bear in mind in any study:

We must obtain *all* the facts from *all the different branches* of science so as to check up our findings and compare them, lest the facts found in one deny those of another; witness, for instance, what Professor Kellogg says—that Paleontologists accept one theory of evolution, Pathologists another, Embryologists still another, and so on.

That probably no one man can co-ordinate all the sciences, for there are so very many branches now, and that just for this reason, we cannot now and probably never can (for there will in all probability be still more divisions of our present branches in the future) be able to arrive at anywhere near a consistent co-ordination of truths in a purely scientific way, for, to know the Truth one must know all

the facts, and as we have just shown, this is practically impossible. We can know these things tentatively but every new finding may change our views, so that, as Professor Kellogg well says, biology (and he might have named other branches as well) is not in such a state that any theories can yet be built upon it. He believes that only one truth has been brought out of biology so far, about which there can be no disputation, and that is "Evolution," but as we have shown, Professor Fleishmann—an equally eminent biologist—denies even this.

That as it is acknowledged by all biologists that there are very few biological facts that can be made use of as truths on which to build theories for the training of children, for Social Psychology, etc., it will be seen that practically all volumes on these subjects which began their theorizing on biological grounds that have not yet been established, and as Kellogg mentions, were even more shakily established than many others that have not been used, are almost worthless.

That most people work on an emotional and not a reasonable basis, and desiring a thing to be true, they read into various facts all manner of meanings that are not true, well illustrating the proverb, "The wish is father to the thought."

That any number of writers use different names for the same thing, while others call different things by the same name, so that one must be positive of the word's meaning before attempting an interpretation, and that on this account, many men who are fighting each other in print, are probably agreed on what they actually believe, but due to a different training and a different nomenclature, they themselves believe they differ from each other.

That if we do not give the student a training in Logic he cannot know that his reasoning is correct even though he may be fairly accurate in its use, and that he must have Logic though he wished to prove that he doesn't need it, for even then, there would have to be the assumption that he could set his facts opposing this idea in logical order.

That what the man on the street means by a Scientist is

one who "applies science," but a *real* Scientist never thinks of including such a one under that title. The true Scientist is he whom the average man would consider a Philosopher.

That no Scientist has ever won acceptance and renown except through his philosophising.

That in Science we cannot explain a single WHY of anything. All we can do is to show HOW to do certain things in order that something else may occur. But WHY this does occur, we do not know.

That there are two kinds of Law. The one referring to the Moral Order and dealing with Right and Wrong, the other a Physical Law, meaning only that two or more occurrences always follow in the same order in so far as we have yet been able to prove. This Physical Law has, of course, nothing whatever to do with Right and Wrong in the Moral Order.

That in Ethics, unless we accept Free-Will and a Creator, we cannot have any Ethics, for each individual would necessarily have to do the things he does, and it would be perfectly absurd to deny any one the "right" to do that which he couldn't help doing, and to punish him therefor.

That there can be no *valid* reason why man should live a decent life if there be no absolute Right and Wrong, which means that a Superior Being established certain laws that must be obeyed, for if man be but a piece of protoplasm developed from the primitive nebulosity until he has become what he is due to purely Physico-chemical laws, Might is Right, and there is no valid reason why he should not procure all he can for his own gratification and care nothing for the injury he may do others.

That if it be objected, that each man seeks happiness, and that injuring his neighbor would cause him unhappiness, it might be answered that that is exactly the point we are making, namely, that there has been impressed upon his conscience by an outside intelligence, an idea of Right and Wrong as well as an idea of Happiness, for if we remember that nothing can be greater than its cause, we must come to the conclusion that the cause of having a Conscience at all

must have been a very great and good intelligence, or we could not have our notions of Intelligence and Good.

That by far the overwhelming majority of great men in biology were "believers" in a Supreme Being, and were likewise quite religious.

That Alfred Russell Wallace, co-founder of the Theory of Natural Selection with Darwin, said in his last book, that there had been absolutely no moral progress since the history of man began.

That Kohlmann, the German Anthropologist, says that "Man has not changed his racial characteristics since the glacial period."

That Kohlbrugge, a great German Biologist, speaking of our knowledge of Evolution says "We do not know anything distinct about the great problem of evolution as yet. We have not quite even seen its face. All must be done over again."

That even Huxley, the great agnostic, had St. Thomas Aquinas, the greatest philosopher of the Scholastic school, as one of his favorite authors.

That this same Professor Huxley had his children brought up in the Anglican Church, because, as Dr. Walsh says, "he thought that Christian principles would protect them through dangerous periods and if later they wanted to choose for themselves, they might do so."

And it is well to remember several of Dr. Walsh's "Scientific Don'ts." [2]

Don't forget that Huxley's "Romanes' Lecture" shows how conservative he became in his later years, and remember that Herbert Spencer in his last book retracts many of his earlier views on religion.

Don't forget the remarks Dean Stanley made as he lay on a sick bed from which it was thought he would never rise: "Life looks very different when viewed from the horizontal." Life and Philosophy look very different viewed from the gathering shadows of the end of life.

Don't forget Francis Bacon's well-known expression "A

[2] Fifty "Don'ts" of Science, by James J. Walsh, M.D. Ph.D., The Catholic Mind, Vol. XIII. No. 6, March 22, 1915.

little philosophy"—by which he meant natural philosophy or, as we call it, science—"inclineth man's mind to atheism, but depth in philosophy bringeth men's minds about to religion."

CHAPTER XII

SUGGESTED READING

OUR object throughout this book has been to give to the reader PERSPECTIVE, in order that he may thereby obtain a more comprehensive view of LIFE; and as a small volume of this nature cannot enter into the details of the many subjects discussed, we are here suggesting a "course" of reading that we believe will be both instructive and profitable to all who will follow it out honestly and thoroughly but, as probably very few will have had the same training, we shall suggest first a list of books for those whose schooling has been but little, and who on that account cannot immediately delve into volumes that will prove more difficult reading.

This first list must be purchased so that the student can go through the works mentioned, thoroughly and constantly, until completely mastered. They must be STUDIED, not merely read.

Logic, by Wm. Turner, S.T.D. (*Catholic Education Press*, Washington) ..... $ 1.25
Dr. Turner is Professor of Philosophy in the Catholic University at Washington, D. C., and his book is the very simplest possible.

Truth and Error, by Aloysius J. Rother, S.J. (B. Herder) ..... .50

Certitude, by Aloysius J. Rother, S.J. (B. Herder) .50

Being, by Aloysius J. Rother, S.J. (B. Herder).. .50
The author of these little books is professor of philosophy in St. Louis University.

Psychology, by Michael Maher, S.J., D.Litt., M.A., (Longmans, Green & Co.) 2.00
Dr. Maher is professor of Psychology at Stonyhurst College, England, and his volume is a vast store-house of all things psychological, both from the Rational and the Experimental side.

Problems of Philosophy, by John Grier Hibben (Scribners) 1.00
Dr. Hibben is president of Princeton University.

Backgrounds for Social Workers, by Edward J. Menge, M.A., Ph.D., M.Sc. (Richard G. Badger 1918) 1.50

General Biology, Sedgewick and Wilson (Henry Holt & Co.) 1.75
Dr. Sedgewick is professor of biology in the Massachusetts Institute of Technology and Dr. Wilson is professor of zoology in Columbia College, New York.

These volumes, if thoroughly mastered, will lay a solid foundation for all future reading.

Should one, however, have had some philosophical training and be able to read more difficult work with understanding, we would suggest that the list of volumes immediately following be made a part of one's library, as well as all of the books in the *outlined course*, which follows this list, that the student can afford.

A Manual of Scholastic Philosophy, by Cardinal Mercier, 2 volumes, (B. Herder) ..... $ 7.00
This is a very complete philosophy covering practically all problems that may arise in the student's mind.

Problems of Philosophy, by John Grier Hibben, (Scribners) 1.00

General Biology, by Sedgewick and Wilson, (Holt & Co.) 1.75

A Text-Book of Zoology, by Parker and Haswell, (Macmillan), 2 volumes 9.00
This is the most complete work on the subject in the English Language.

Stonyhurst Series of Philosophy, (Longmans, Green & Co.). There are eight volumes in this series not all of equal value. They are written by the professors of Stonyhurst College, England, and treat Scholastic Philosophy from a modern viewpoint as does also the work of Cardinal Mercier, quoted above. It is not necessary to have both Mercier's Manual and these eight volumes, but Maher's Psychology should be had, on account of the vast field it covers.

Natural Theology, by Bernard Boedder, S.J..... 2.00
Logic, by Richard F. Clarke, S.J..... 1.50
Political Economy, by Charles S. Devas, M.A..... 2.25
Psychology, by Michael Maher, S.J., Litt. D., M.A. 2.00
The First Principles of Knowledge, by John Rickaby, S.J. 1.50
Moral Philosophy, by Joseph Rickaby, S.J..... 1.50
General Metaphysics, by John Rickaby, S.J..... 1.50
Theories of Knowledge, by Leslie J. Walker, S.J... 2.75

The outline we are here suggesting has been formed with the idea of presenting both sides of the question, so a rather varied list of articles and books are cited, but we would have the student remember that as these articles and books were not especially written to form a *course* of connected reading, there will be some repetition and often a running off into by-paths that have little to do with the subject, but that is a fault one must always find in the collateral reading one may follow.

We also wish to call attention to the fact that with the *Encyclopedia Britannica* and the *Catholic Encyclopedia* there are excellent index volumes, which should always be

consulted *first* when looking up any subject whatever, for often the thing sought may be part of an article listed under a totally different name and in a totally different volume from what one might suppose.

Further, it must be borne in mind that until the three important Encyclopedias we mention have been consulted on *every* article under discussion, the student must not consider himself free from a one-sided viewpoint, remembering that a fact will be the same in each case though each fact may be viewed from a vastly different angle.

Then it is well to remember that the *Encyclopedia Britannica* is written largely by Protestants, the *Catholic Encyclopedia* by Catholics and the *Jewish Encyclopedia* by Jews, thus giving one an authoritative account from these three angles.

Outline of Study

Philosophy and Common Sense, by Dr. Orestes Brownson, Vol. 1, Page 1, of Brownson's Collected Works, which can be found in any large library.

Problems of Philosophy, by John Grier Hibben.

Logic.

Dante and Aquinas, by Philip H. Wicksteed, (Dutton & Co.) ..... $ 2.00

This little volume will prove an interesting and valuable introduction to those desiring to familiarize themselves with the viewpoint and terminology of Scholasticism.

General Biology, by Sedgewick and Wilson.

Scholasticism, Old and New, by M. M. C. J. de Wulf (Benziger) 2.00

Professor de Wulf was formerly at the University of Louvain and is now at Harvard.

Christian Philosophy, by J. T. Driscoll (Benziger) 1.25

The Revival of Scholastic Philosophy in the Nine-

teenth Century, by Joseph Louis Perrier, Ph.D. (*Columbia University Press*) 1.75

Mercier's Manual of Scholastic Philosophy or *The Stonyhurst Series of Philosophical Studies.*

History of Philosophy, by Wm. Turner, S.T.D. (Ginn & Co.) 2.50

Biology and Its Makers, by Wm. A Locy, (Henry Holt & Co.) 2.75

Darwinism To-Day, by Vernon Kellogg, (Henry Holt & Co.) 2.00

Essays in Unnatural History, by John Gerard, S.J., F.L.S. (Herder) 1.25

This volume having been written in 1900 refutes much that needs no refutation to-day, but nevertheless it is good reading on the history of the development of many so-called scientific ideas that are no longer accepted.

Studies in American Philosophy, The Modern Schools: Evolutionism, by the Rev. J. B. Ceulemans, *Ecclesiastical Review*, Sept.1912, page 258.

The First Principles of Evolution, by S. Herbert, M.D., M.R.C.S. (Eng.) L.R.C.P. (Lond.) (Macmillan) 1.60

Easy to read and covers both inorganic and organic evolution, BUT one must not forget one's logic, for the author often arrives at conclusions that are not exactly sound, logically.

Facts and Theories, by Sir Bertram Windle, M.A., M.D., Sc.D., LL. D., F.R.S., K.S.G., President of University College, Cork, (Herder) ..... .45

The Problem of Evolution, by Erich Wasmann, S.J. (Herder) 1.60

This is an account of a most interesting public discussion held in Berlin, in 1907, between disciples of Professor Haeckel and Professor Wasmann himself, who, by the way, is one of the great authorities, if not the greatest on Ant Life.

What is Life? by Sir Bertram Windle, (Herder).. .75
The Conservation of Energy and Voluntary Activity, by the Rev. Michael O'Kane, O.P., in *American Catholic Quarterly Review*, July, 1903, Page 588.
A Recent Argument against Vitalism, by the Rev. A. M. Schwitalla, S.J. *Ecclesiastical Review*, Feb. 1913, Pages 136-149.
The Life in Separated Human Tissues, by Austin O'Malley, M.D., *Ecclesiastical Review*, October, 1914, Page 464.
Modern Biology and the Theory of Evolution, by Erich Wasmann, (Herder)..... 4.50
Genetics, by Herbert Eugene Walter, (Macmillan) 1.50
Instinct and Intelligence in the Animal Kingdom, by Erich Wasmann, (Herder)..... 1.00
Brain and Personality, by Wm. Hanna Thomson, (Dodd, Mead & Co.)..... 1.20

For those whose interests lie in the biological realm, and who wish to read more extensively along their chosen line, we suggest:

Origin of Species, by Charles Darwin.
Voyage of the Beagle, by Charles Darwin.
Text-book of Zoogeography, by Frank Evers Beddard, (Putnams) $1.50
Behavior of the Lower Organisms, by H. S. Jennings, (Columbia Univ. Press)..... 3.00
Heredity, in its relation to Eugenics, by Chas. B. Davenport, (Henry Holt & Co.)..... 2.00
Ants, by Wm. Morton Wheeler, Ph.D. (Columbia Univ. Press) 5.00
Species and Varieties, by Hugo de Vries, (Open Court Pub. Co.)..... 5.00
Mendel's Principles of Heredity, by W. Bateson, (Putnams) 3.50
Thoughts of a Catholic Anatomist, by Thomas Dwight, M.D., LL.D., (Longmans, Green & Co.) 1.00

On the Psychological side, read:

The Century's Progress in Experimental Psychology, by Henry Smith Williams, M.D., *Harpers Magazine*, September, 1899, Page 512.

Fact and Fable in Psychology, by Joseph Jastrow, Ph.D., (Houghton Mifflin Co.)..... 2.00
Professor Jastrow is head of the department of Psychology in the University of Wisconsin.

Genetic Psychology, by Edwin A. Kirkpatrick, B.S., M.Ph., (Macmillan) 1.25

Psychology for Teachers, by Charles H. Judd, (Appleton & Co.)..... 1.20

Education of the Central Nervous System, by Reuben Post Hallack, (Macmillan)..... 1.00

From the animal side of psychology, we have these excellent books:

Behavior, An Introduction to Comparative Psychology, by John B. Watson, Professor of Psychology in the Johns Hopkins University. (Henry Holt & Co.)..... 1.75

Lectures on Human and Animal Psychology, by Wilhelm Wundt, (Macmillan)..... 2.60

The Animal Mind, by Margaret Floy Washburn, Ph.D., Professor of Psychology in Vassar College, (Macmillan) 1.60

Instinct and Intelligence in the Animal Kingdom, by Erich Wasmann, S.J. (Herder) Already quoted. 1.00

Comparative Studies in Psychology of Ants and of Higher Animals, by Erich Wasmann, (Herder) 1.00

Founders of Modern Psychology, by G. Stanley Hall, President of Clark University. (D. Appleton & Co.)..... 2.50
Rather difficult reading unless one is familiar with philosophy.

All that have been cited so far are, of course, a part of the literature that makes for a general knowledge on the

subjects discussed, but the following books are especially interesting as they deal more with the philosophy of biology direct.

The Freedom of Science, by Joseph Donat, S.J., D.D., (Joseph F. Wagner, New York)..... $ 2.50
Dr. Donat is a professor in Innsbruck University.

The Great Enigma, by W. S. Lilly, (D. Appleton & Co.) 3.60

The Science and Philosophy of the Organism, by Hans Driesch, Ph.D., Professor in the University of Heidelberg, and Gifford Lecturer in the University of Aberdeen for 1907-1908. 2 volumes, (Macmillan) 6.00

The Problem of Individuality, by Hans Driesch (Macmillan).

The History and Theory of Vitalism, by Hans Driesch, (Macmillan) 1.75
Quite difficult reading unless one is familiar with both biology and philosophy.

Mechanism, Life and Personality, by J. S. Haldane, M.D., LL.D., F.R.S., (London).

Continuity, The British Association Presidential Address, 1913, by Sir Oliver Lodge, D.Sc., F.R.S. (London, 1913).

Some Intimations of Immortality, by the Rt. Hon. Sir Edward Fry, G.C.S., (London, 1913).
The last three volumes differ with Professor Driesch to a very considerable extent and will therefore prove quite interesting.

See *The Hibbert Journal* "Reviews," Vol. XII, Page 706, for a review of these three and Vol. XIII, page 438 for a review of Professor Driesch's volumes, both reviews are by O. W. Griffith.

Modern Science and the Illusions of Professor Bergson, by Hugh S. R. Elliot, with preface by Sir Ray Lankester, K.C.B., F.R.S., (Longman's, Green & Co.) 1.60
This book challenges the "right of philosophy to

intrude into the sphere of science," but is in turn answered by

The Limitations of Science, by Louis T. More, (Henry Holt) 1.50

The following articles in various Journals, easily obtainable at any Library of importance, are also of interest:

Mind and Matter, a Hylozoistic View, by Fleet-surgeon C. Marsh Beadnell, R.N., *Hibbert Journal*, Vol. XIII, Page 605.

A Physiologist's View of Life and Mind, by D. Noel Paton, Professor of Physiology in the University of Glasgow. *Hibbert Journal*, Vol. XIII, Page 367.

A Recent Work on Primitive Revelation and Modern Science, by the Rev. John D. Folghera, O.P. *Ecclesiastical Review*, April, 1914.

Science in "Bondage," by Sir Bertram Windle, *The Catholic World*, February, 1917.

Religion as a Credible Faith, by W. H. Mallock. This book is quite interesting on account of the attempt the author makes to harmonize supposedly conflicting facts. Published by Macmillan in 1903; it should be read and then, the answer to that part dealing with Maher's Psychology, will be found in the 1914 edition of Maher's Psychology; also read these criticisms immediately following the reading of the volume:

Mr. Mallock on Science and Religion, by Rev. S. Fitz Simons, *The American Catholic Quarterly Review*, January, 1904. Vol. XXIX, Page 74.

Mr. Mallock as a Defender of Natural Religion, by E. R. Hull, S.J., *The American Catholic Quarterly Review*, July, 1896. Vol. XXI, No. 83.

The Problem of Evolution, by Erich Wasmann, S.J. Already quoted, is reviewed and objected to by the article:

Father Wasmann on Evolution, by Rev. S. Fitz Simons, *American Catholic Quarterly Review*, January, 1910. Page 12. Vol. XXXV. No. 137, Page 12. This is a good summary by one who absolutely refuses to accept any evolution

whatever.

History of the Warfare of Science with Theology in Christendom, by Andrew Dickson White, (D. Appleton & Co.) 2 volumes, $5.00. A work whose reading is suggested at many of our great schools, but it should be read in conjunction with the following:

Critique of White's "Warfare," Vol. 16, Page 597. *Ecclesiastical Review* and

Christian Faith and Modern Science, by the V. Rev. John B. Hogan, SS. D.D., *American Catholic Quarterly Review*, April, 1897, Vol. XXII, Page 382.

For Draper's works though thoroughly discredited, but often referred to, see article "Science" *Catholic Encyclopedia*. See also the following articles in the three *Encyclopedias* mentioned.

Biology, Evolution, Medicine, Life, Cell, Vitalism, Anatomy, Physiology, Instinct, Heredity, Eugenics, Psychology, Botany, Zoology, Biogenesis, Abiogenesis, Autogeny, Ethics, Science.

See also Reading Lists on Biology and Philosophy, in both *Encyclopedia Britannica* and the *Catholic Encyclopedia*, in the last volume of each.

Consult the "*Periodical Index*" found in any library for special articles appearing in the various journals; but remember that in reading these articles when a statement is simply made without evidence adduced to support it, though it be quoted until it is known by nearly every one, the statement need not be true; for, often one man, wholly irresponsible, has said something which others have copied until the very fact that it is so often quoted gives it a semblance of truth.

Consult the annual index or semi-annual index of the following high grade journals, for many interesting articles:

The North American Review,
The Atlantic Monthly,
The Hibbert Journal,
The American Catholic Quarterly Review,
The Catholic World,

The Dublin Review,
The Unpopular Review.

This list is by no means exhaustive and its aim has been to open up a world of broader vision for the student than he would be likely to obtain by the usual suggestions given him.

As we have stated in our chapter on "The Ideal," it is the province of Religion to begin where we have left off. So we would suggest the following two volumes for reading in this region.

Constructive Natural Theology, by Newman Smyth, (Scribner) $1.00
From the Protestant viewpoint, and
Natural Religion, by Franz Hettinger, D.D. (Fr. Pustet & Co.)..... 2.00
From the Catholic side. Dr. Hettinger was professor of Theology in the University of Wurzburg.

We have given only those articles and volumes which are written in the English language. There are of course, many more than we have cited, and in German and French even a great many more than there are in English, but for those who can read either of these languages in the original the references and notes in the volumes cited will furnish sufficient material for a most extended effort.

There is one more point that we must not fail to mention, and it is that of Vestigial or Rudimentary Organs and those similarities of structure known as Homologies between Men and Animals. We cannot treat so vast a subject very fully here, but we can show the student where he may find the references he wishes:

Evolution of Man, by Jas. Walsh, M.D., Ph.D., Litt.D., etc. Article in *The Catholic World*, May, 1916, pp. 207-

218.

Regarding Haeckel's Biogenetic Law, that is, that each individual passes through the same stages that the race has passed through. See,

Wasmann's *Biology*, page 456 and 445 and 446.

Wasmann's *Biology*, (English Translation) in the Appendix, l.c. page 503 and 487.

Kellogg's *Darwinism To-day*, Page 21, where he says the "Recapitulation theory is mostly wrong." (This is Haeckel's Biogenetic Law) and in another place he adds that this theory now forms only a skeleton on which to hang exceptions. See also page 130, where Professor Kellogg says that Haeckel still continues to cling to discredited theories.

Ranke's *Der Mensch*, (Third Edition) I. page 311-314, and the whole of section 306 to 314. Ranke is an authority so no one need fear quoting him.

T. Thesing's *Experimentelle Biologie*, II. (Volume 337 of the collection *Aus Natur und Geistes Welt*.

Biologische Zentralblatt, XXXVI, 1906, No. 21, pages 754-768. Article, "Neuerere und Neueste Schilddruesenforschung" by O. Schulz. Consult any Medical Library for this. Wasmann cites it, I. page 446.

Stimmen aus Maria Laach, 1911, No. 4. This covers Evolution as it applies to man, by Karl Frank, S.J. See page 16 for the mention of Rudimentary Organs.

Neueres zur Abstummungslehre, in *Revue Luxembourgeoise*, 1910, No. 2, by E. Wasmann.

In regard to rudimentary organs, we are daily finding reasons for their existence. A few years ago the ductless glands were so considered, but now we know they produce some substance that other glands must have to continue their work, and similarity of structure does not denote similarity of ancestry any more than dissimilarity denotes that the organisms possessing it sprang from different parentage.

At any of the larger universities a great number of tech-

nical journals may be found, usually in the departmental libraries, on all Biological, Psychological, Philosophical and other branches of Science, and we suggest consulting these also.

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